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MAY 9 1912 PERIODICAL DEPT.

BENJAMIN
9-0-3
ATTACHMENT PLUG
BODY ENTERS WITHOUT ROTATION
ROTATING SLEEVE ATTACHES PLUG
CAP CONTAINS CORD GRIP
BENJAMIN
THE BENJAMIN 903 ATTACHMENT PLUG
enjoys the distinction of being the neatest and most practical attachment plug on the market. Its growing popularity with the user may primarily be accounted for by its ingeniously devised rotating sleeve—a feature protected by patents—which makes it possible to attach or detach the plug quickly without turning the device or twisting the cord. It has an effectual cord-gripping means in the cap, presents a finished appearance, and is practically immune against breakage. Furthermore, it combines its individual features with such singular success, that the completed device shows a margin of excellence unattained in any other. This explains its hold upon the trade.
Patent Rotating Sleeve
Effective Cord Grip
Rugged Construction
Pleasing Appearance
BENJAMIN ELECTRIC MFG CO.
CHICAGO
SAN FRANCISCO
NEW YORK
151 New Montgomery Street
Write us on your Annual Requirements

O-B Cast Trolley Ears

Figure 1. Showing Boss Before Being Tapped Out.

Figure 2. Showing Threaded Hole for Stud, Tapped Exactly in Center of Boss.

Figure 3. Showing Runner Portion Cast Solid—Before Groove Is Milled Out.

Figure 4. Showing Groove for Wire Milled Out Accurately—Leaving Knife-Edge on Lips Without Grinding.

O-B Cast Ears versus "Local" Foundry Ears

O-B Cast Ears are made of a special bronze mixture that is kept absolutely uniform as a result of 21 years' knowledge of metal mixing and by chemical analysis of every heat. No scrap metal is used. Boss and runner piece are cast solid as shown in Figs. 1 and 3.

Hole is tapped *exactly in center* of boss; groove for wire is milled out *accurately to size*, leaving knife edge on lips *without any grinding*.

Results:—

1. Extremely long life and uniformity of service.
2. Smooth under-run for wheel because groove fits wire and lips are thin without being brittle.
3. First cost a trifle high but ultimate cost less because of less frequent renewals being necessary.

Many "local" foundries make ears from a mixture of scrap brass composed of all sorts of odds and ends. Groove for wire is cast into ears and ground out on inside and lips are then ground on outside.

Results:—

1. Lack of uniformity in wearing qualities because of variations in metal mixtures.
2. Grooves vary in size, lips vary in thickness and are made brittle by grinding. Boss is tapped indifferently, often out of center.
3. Low first cost but short average service and consequent high maintenance expense.

Give O-B Ears a Chance to Prove Their Ultimate Economy to You.

The Ohio Brass Co., Mansfield, Ohio

Holabird-Reynolds Company - San Francisco and Los Angeles

CALIFORNIA AGENTS FOR ALL O-B PRODUCTS

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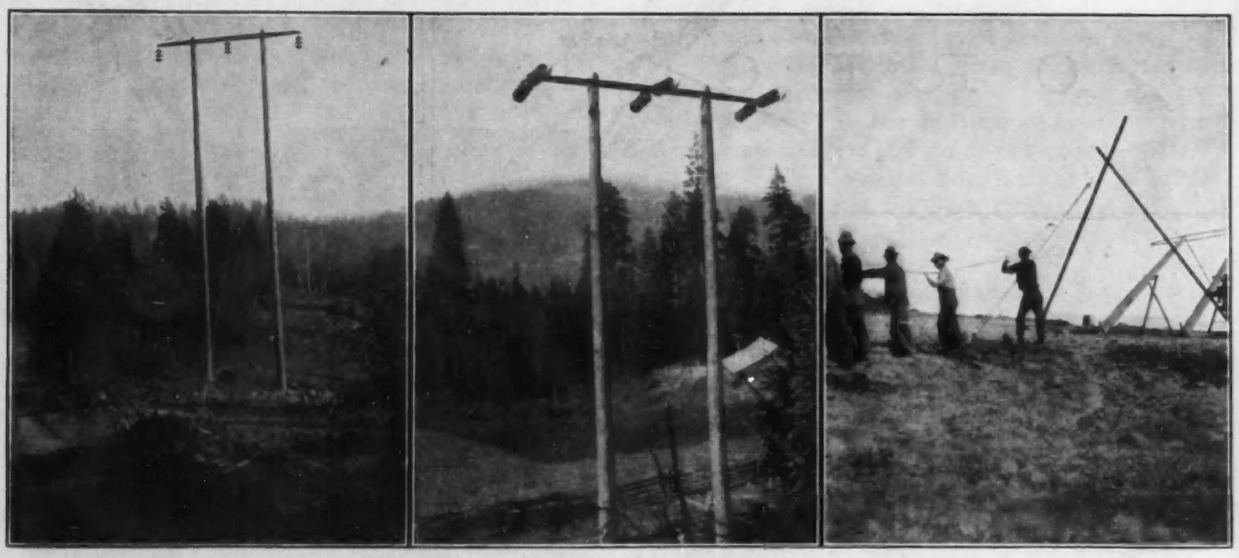
NOVEL WOODEN TOWER LINE CONSTRUCTION

BY O. G. STEELE.

The manner and method of constructing the 60,000 volt wooden tower line of the California-Oregon Power Company involves several unique features which make a description and detailed cost statement of considerable engineering interest.

This transmission line is 24.6 miles in length, connecting the Fall Creek power plant of the California-Oregon Power Company, about 2½ miles south of the California-Oregon line, with the town of Ashland in Southern Oregon. It ties in with the extensive system which the company has recently acquired by the consolidation of the Siskiyou Electric Light & Power Company, the Rogue River Electric Company and surrounding plants.



Wooden Pole Towers Showing Method of Erection.

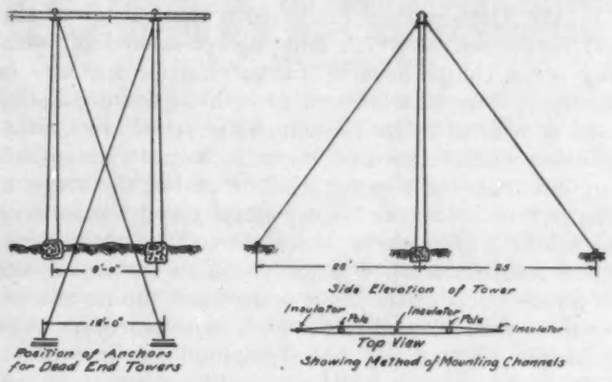
The plants in operation in this system are the Fall Creek plant in Siskiyou County, California, the Gold Ray plant in Jackson County, Oregon, and the Prospect plant at Prospect, Oregon. The former plant is situated on Fall Creek, a tributary of the Klamath River and is about one-half a mile from the mouth of that river and within one hundred yards of the Klamath Lake Railroad. The two latter plants are both on the Rogue River. In addition to these three plants there are also two hydroelectric plants at Klamath Falls on the Link River and the Shasta River plant four miles north of Yreka, Cal.

Construction work is also being rushed to complete the first two 10,000 kw. units on a new installation on the Klamath River about a mile and a half east of the Fall Creek plant. Since the Fall Creek plant is very nearly the geometric center of the system, as seen from the map, it will handle the dispatching for the entire system.

The Fall Creek plant, constructed during the winter of 1902-1903, being the first generating station of the company, has an interesting history. This plant as completed in 1909 has a capacity of 3200 kw., which energy is generated at 2300 volts, 60 cycles per second, three-phase. It is then transformed to 22,500 volts delta for transmission.

Four lines are run out of Fall Creek to various parts of the country. Line No. 1 takes a southerly course to Etna Mills, a distance of 55 miles, tapping Hornbrook, Yreka, Montague, Ft. Jones and Greenview. Enroute, mines are electrically supplied on the Klamath River, Humbug, Cherry Creek, McAdams Creek, Indian Creek, Patterson Creek, Oro Fino and Quartz Valley.

Transmission Lines of California Oregon Power Co.



Details of Tower.

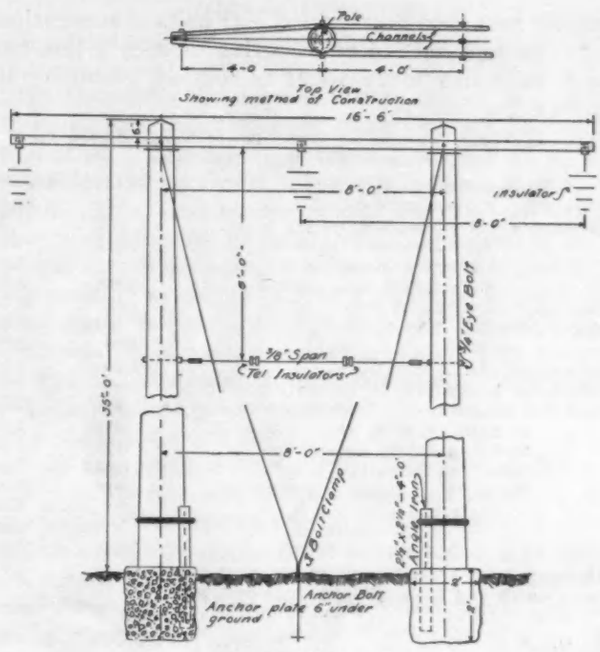
Line No. 2 runs due south to Castella, a distance of 75 miles, passing through Dunsmuir, Sisson, Weed, Big Springs and Shasta Valley. Line No. 3, on the other hand, takes a northwesterly course 24.6 miles to Ashland, Ore., where it connects with the Rogue River system. Finally, line No. 4 completes the points of the compass by taking a course due east to Dorris, 23 miles distant, thence north to Klamath Falls, a distance of 20 miles.

The first two lines mentioned are of the ordinary single pole construction, line No. 1 being constructed for 30,000 volts and line No. 2 for 60,000 volts, single circuit, three-phase. Lines No. 3 and No. 4, however, are of the two-pole type set on concrete bases and anchored at the front and rear as shown in the illustrations. Spans vary from 450 to 1000 feet., one span being 1465 ft. across Jennie Creek Canyon.

Concrete Bases for Poles.

Cast iron anchor plates were used in the foundation work while 3 in. channel iron was employed for the cross-arms. These arms are 16.6 ft. long and are painted with P. & B. paint to prevent rusting. Angle iron 2½ x 2½ in. was used to bind the poles to the concrete bases shown in the illustration. Insulators of the Locke suspension type are employed. Each insulator, composed of three units, clasps the conductor by means of a straight line clamp. At the point where angles are necessary in the transmission line four units are employed in the insulator.

Every fifth tower is so constructed as to take up



Details of Tower.

the strain at these strain towers, four anchors are employed with guy wires crossed, while for standard towers only two anchor plates are employed.

The raising of the towers proved an interesting problem due to the roughness of the country encountered. While the hillside, composing a portion of the transmission line made only one method applicable, it was not at all times practicable to deliver the tools required. In the illustration one of the best methods of performing this is shown in which a crew of twelve to fifteen men are employed.

The poles are first placed on supports about seven feet above the ground. The guy wires are next passed over the fork as shown and with the aid of a block and tackle the poles are pulled into place, during which process men with pike poles properly guide them. After the poles are thus set on their bases, the guys are pulled through the eye of the anchor rod and simply tightened by hand, another crew following the first one put the guy wires in final taut condition. Later in the progress of the work, it was found that a horse could be used to raise the towers and this method proved satisfactory. As many as twenty-five of these towers may be thus raised in one day. Referring to the guy clamps, the ordinary three-bolt galvanized type was employed but in the future the combination clamp will replace the three bolt design.

An average of ten towers per mile were necessary in the construction of the transmission line, although this varied somewhat wherever rolling country prevailed. Thus in crossing canyons, spans were made of full length in most cases. The country through which lines No. 3 and No. 4 pass is rough and in the construction it became necessary to use pack mules in the delivery of cement, water and other material along the line.

In dead ending the towers the conductors are passed over the straight line clamp direct to the anchor plates in the ground, the suspension type of in-

sulator here used necessitated four units of suspension.

The unit cost of construction of such a line has been estimated to be about as follows, assuming 10 towers per mile:

Average Cost Per Mile of Wood Tower Transmission Line. 10 Towers Per Mile, 24.6 Miles.

Wire 3 No. 2 Copper, 3242 lb.	@ $0.155	$502.51
Wire 2 No. 9, Iron, 1053 lb.	.05	52.65
Insulators, 100 suspension units	.775	77.50
33 suspension eyes	.125	4.13
7 strain clamps	.74	5.18
30 straight line clamps	.364	10.91
Channel Iron Arms, 10 sets of 2, 132 lbs.	.033	43.56
Angle Iron, 338 lbs.	.0298	10.00
Cement, 4.35 bbls	3.74	16.30
Gravel, 6.3 yds.	.25	1.57
Telephone Insulators, 21 No. 26	.05	1.05
Pole line Hardware 24 bolts ⅝ x 8 in.	.088	20.00
20 bolts, ⅝ x 1¾ in.	.0368	7.72
50-3 bolt ¾ in. guy clamps	.151	7.55
50-½ in. thimbles	.0312	1.56
250 ft. ⅜ in. strain guy cables	.016	40.00
25 guy rods, ½ in. x 6 ft.	.36	9.00
450 lb. anchor plates	.03658	16.36
Poles, 20-40 ft. red fir	1.629	32.58
Right of Way, average cost of securing		16.85
Camp outfit and tools, proportional cost per mile		20.00
Total		$896.78
Labor:		
Surveying right-of-way		$ 64.00
Clearing right-of-way		148.20
Hole digging, 20 foundation holes, 2 ft. deep and 25 guy holes, 5 ft. deep		79.00
Powder		6.95
Tower framing, 10 towers	@ 2.29	22.90
Haulage, including cost of teams, hay and grain:		
20 poles, average 2 miles	@ 3.037	60.74
Wire, average cost per mile		20.51
Channel iron arms including painting		14.50
Foundation materials		25.80
Setting 20 foundations (concrete)	@ 5.51	110.20
Raising 20 towers at	@ 5.538	110.76
Wire stringing 3 copper transmission and 2 iron telephone		73.60
Extras, blacksmithing, coal and labor		10.00
Warehouse man		4.00
Time-keeping and books		14.00
Superintendence		28.50
Total		$783.66
Miscellaneous:		
Camp expense, moving, depreciation in maintenance of automobile		$ 86.00
Loss on cook house after serving 14,930 meals at 35c		7.56
Numbering, repairing and distributing material for future repairs		25.80
Total		$ 109.36
Grand total		$1789.80

FUNDAMENTALS OF A COMPREHENSIVE TRANSIT PLAN.

At the annual public meeting of Alpha of Tau Beta Pi, the engineering honor society, at the University of California, Mr. Geo. A. Damon, engineer with Bion J. Arnold at Los Angeles and dean of the Throop Polytechnic Institute, delivered an address on the "Fundamentals of a Comprehensive Transit Plan."

In introducing the subject Mr. Damon illustrated the importance of adequate transportation to every community as the people pay more for passenger transit than they do for taxes, and more for street car fares than for all other public utility service combined. The tendency toward public regulation by State commissions, by local utility boards and by contract ordinances, was described and the importance of the public's knowing the fundamental truth as to the financial and technical requirements of the transportation problem was emphasized.

Mr. Damon then discussed a number of technical fundamentals which must be considered in working out a comprehensive transit plan for any city or district. The location and growth of the population was shown to follow the natural physical laws of expansion, contraction and crystallization. The spreading out from the first "origin" or center, the shape of the city as influenced by topography and the forming of satellite sub-centers was shown. The planning of good transportation was compared to the laying out of an electrical distribution system and the rapid transit lines were likened to the high tension feeders. The principle of "radials" and "circuits" for transportation main arteries and cross connections was explained. That transportation increased at a rate even greater than the square of the increase in population was shown to be a most important fundamental—as it demonstrated that the "riding habit" could be cultivated and that rapid transit would create a large amount of new business. The decrease in cost with the increase in density of traffic and the necessity of operating cars in trains in order to get the full benefit of the physical capacity of any line are important points in favor of establishing a zone system of construction and operation, consisting of subways in the congested district, fed by elevated or open cut lines in the next zone of population density and finally ending with a system of surface car lines for collection and distribution in the suburban districts. The constantly growing demands for the investment of additional money in transportation facilities was shown and the fact that when the population doubles the actual investment must be increased by from four to six times was brought out to show the importance of developing some system to protect this investment. The principles of public regulation of utilities were discussed—the securing of adequate service being put first, the protection of the actual investment at a a fair rate of return second, and the fixing of reasonable rates third. The duty of the engineer in taking a larger part in the problem of public control was pointed out and the contributions of the technical men in working out the principles of depreciation, obsolescence, decapitalization and amortization were referred to as examples of the problems which must be solved before we get the full benefits of scientific regulation.

The essential features of the address were then illustrated by a series of lantern slides showing the Arnold method of attacking a transportation problem —including dot maps showing the location of the "sleeping population," growth of population diagrams and charts, time zone maps to investigate rapid transit developments and rush hour seat and car diagrams to indicate the daily flow of traffic. Drawings and photographs of subways, elevated and open cut lines indicated the importance of making the transportation arrangements the back-bone of a modern city plan. A final diagram showed how the settlement ordinance of Chicago has resulted in a stable balance between the requirements for operating expenses, renewal fund, return on the investment and the division of the surplus between the city and the companies which had set a high standard in the evolution of transportation developments.

SOME FEATURES OF RATE FIXING FOR ELECTRIC PUBLIC SERVICE PROPERTIES[1]

BY GEORGE L. HOXIE.

Rate-fixing is one of the newer engineering problems. It is true that rate-fixing commissions have been, and are, largely composed of lawyers, but the members of all of these commissions have found it necessary to rely largely upon their engineering experts, and it seems to the writer entirely probable, as well as desirable, that the engineering profession should in the future have an increasing share in handling rate-fixing matters. It seems probable that for some time to come there will be a steadily increasing number of engineers either employed directly by commissions, or employed by public service corporations in connection with the work of commissions. It is therefore important that engineers should devote some attention to the problems of rate-fixing.

Rate-fixing is designed to accomplish three objects. First, that the people served by a public utility shall pay the lowest rate possible, consistent with efficient service and a proper return on the investment of the corporation. Second, that each class of consumers pay its proper proportion of the total revenues. Third, that there shall be no discrimination between individual consumers of any given class.

The third problem is not difficult. It is only necessary to pass laws forbidding discrimination and to see that those laws are not evaded. There is no difference of opinion as to the desirability of preventing discrimination, and there is little difference of opinion as to what constitutes discrimination.

The other two problems are difficult. Taking up the first question, it must be determined primarily what is a "proper return," and second, what constitutes "investment." We will consider to begin with the case of a successful public utility. (It is obvious that a utility that was not needed by the people served, or one that is operated at such cost that the people served cannot afford to pay a proper return on the cost, cannot be subjected to the same rules that apply to a successful utility.) The consumers served by a successful corporation can afford to pay, and should pay, annually a sum of money sufficient to cover:

(a) The usual rate of interest on safe investments.

(b) An additional sum to compensate for whatever special risk the business of the public utility may involve; and

(c) Such excess profits as are necessary to induce capital to engage in the business.

Item (c), covering profits necessary to induce capital to engage in the business, is somewhat akin to item (b) and in fact the two items might be combined, yet there are some real differences and it has therefore been thought proper to include the third item, coving inducement. Capital is usually induced to engage in a business by a promoter. Item (c) may therefore be thought of as represented in part by promotion stock, or by the earnings of promotion stock.

[1]Abstract of paper presented to Engineers and Architects Association of Southern California, April 18, 1912.

What Is Investment.

Investment may be in money, or in services. The latter is as real as the former. The fact that services have frequently been groosly over-valued has led to a feeling that the investment of services should not be permitted. This seems wrong. The services of the promoter, for instance, may usually best be paid in stock. This amounts to saying that the services of the promoter may be capitalized. The danger is of course that stock being sometimes simply a matter of the printing press, an excessive payment is made for promotion, and the public is thereafter charged with the necessity of paying dividends upon a large amount of water. Promotion stock in fact is not water unless it be issued to a greater amount than the actual services of the promoter justify.

In appraising a public utility just put together and ready to operate, the writer would include in the appraisal, besides figures representing the cost in place of each physical item, (cost of engineering, cost of insurance, etc.), also the exact cost of putting together the corporation, (cost of legal work, etc.), and besides these would include payment for the energy and initiative used on the scheme as a whole, under the head of "Cost of Promotion." All the items on the schedule added together would then be the true "Investment" when the entire plant stands ready to begin operation.

Franchise Value.

In most rate-fixing investigations the franchise itself is not permitted to be regarded as an investment on which earnings are made. This is not necessarily the case, however, as it frequently costs money to get a franchise, and the terms of the franchise frequently involve an annual expense to the company. For example it is not uncommon for an electric lighting company as a condition of its franchise to engage to supply electricity to various public buildings free of charge, or the company may as a condition of its franchise engage to perform street lighting at an especially low rate. Where any of these elements are found the franchise represents either a real legitimate initial expenditure, or a constant annual expenditure, and in either case the franchise may reasonably be regarded as capital on which case revenues must be earned. In the latter case the expenditures may with equal justice be charged instead as operating expenses, if for any reason this is preferred as a matter of bookkeeping.

Going Value.

Assuming that we have decided what constitutes "investment' for an enterprise just completed and ready to operate; what is "investment" for "going concern?" It is rather obvious that a completely equipped utility company ready to operate, but having no customers, has a different value from the same utility a little later when we may assume that its total product is being sold at a remunerative figure. The difference in value between a company without customers and the same company under full operation may reasonably be considered as represented by the cost of putting the company into the latter condition; in

other words, the cost of establishing the business. This sum is represented by early losses, or by the failure to earn proper profits, in the early years of operation.

Depreciation.

There is a wide difference of opinion as to proper methods of figuring depreciation and even as to what constitutes depreciation. It will therefore be assumed that depreciation is figured on a straight line basis, using the assumed useful life of the various items making up the total investment as a basis for determining the yearly charge against each item to cover depreciation. It is also assumed that depreciation has only one value at a given moment for a given item. The items of cost of franchise if any, and the costs of general engineering, superintendence, insurance, law, promotion, going value, etc., should be subject to a depreciation charge as well as are the items covering actual physical property. This means, of course, that such intangible costs as those just enumerated are to be written off, or amortized, in the course of time.

The bookkeeping in connection with depreciation expenditures should be wholly under the control of the commission, that it may be made certain that no part of the plant, built with depreciation money, is capitalized, even though the depreciation fund proves in the course of several years, to have been larger than was really necessary. This, of course, applies to additions made under regulation and not to additions made out of surplus earnings before the advent of rate regulation.

If after determining a proper income to be allowed, it be found for a particular corporation that its stock and bonds have enjoyed a wide market, and have been generally distributed and would be considerably depreciated by the revenue proposed to be allowed, then it seems to the writer that a commission may reasonably allow weight to such a state of facts. On the one hand a strict ruling will bring an immediate loss upon the investor, and on the other hand if the strict ruling be not followed a loss is thrown upon the general public, by collecting from them higher rates than are necessary. A newly organized commission might very reasonably compromise by fixing a term of years at the end of which strict rulings will generally apply, and in the meantime gradually lower the rates during said term. Such a course does not correct past injustice, but it divides the losses resulting from injustice between the stockholder who has made an unfortunate investment, and the public that permitted the unfortunate conditions to exist.

Detail of Rates.

In the writer's opinion the revenue collected should be based ultimately upon the "present value" (reproduction cost, less straight line depreciation) of all physical and non-physical items of property necessary to the service sold. The revenue should be sufficient to cover operating expenses; depreciation charges; and income upon "present value."

It would seem at first sight that if an agreement be once reached on total revenue to be collected the rate problem would be practically solved. Such is by no means the case. It is hardly too much to say that some of the hardest problems still remain. These problems do not seem to be of such a nature that any general solution may be indicated, but they are well worth discussion.

For illustration, let us consider the case of a company whose sole business is the manufacture and sale of electricity. There are many public service enterprises that handle a far more complex business, but this will suffice for illustration. It would probably be found that such a company is retailing electricity in small quantities for domestic purposes; that it is supplying energy for small motors over a wide area; current for small stores scattered through the residence districts of town; lighting for apartment houses over quite a wide area; lighting for hotels and department stores in the business districts; street lighting, probably of at least two kinds; current for electric elevators; current for manufacturing; current for pumping water, and probably also current for operating electric railways.

Not only is every one of the classes of service mentioned supplied at different cost to the company, considering that particular class of load alone, but the cost of supplying each class is vitally affected by the presence of the other classes, i.e., by "diversity factor."

It will almost invariably be found that the public have no proper conception of the necessary difference in cost per kw.h. between supplying a householder with lighting current say to the amount of 20 to 30 kw.h. per month, current being delivered around 100 volts, and the current measured being used a short time per day while an unmeasured all day loss goes on in the customer's individual transformer; and the cost per kw.h. of supplying say 500,000 kw.h. per month, at say 10,000 volts, to a railway company. It is rarely pointed out that a company is fairly lucky if a kilowatt hour at 100 volts, measured inside a customer's residence, does not mean pretty nearly two kilowatt hours measured back on the high tension line.

The author inclines very much toward putting residences using current mainly for lighting, into a single class. Let us say that the shape of the daily load curve is about the same for all such customers. Let us then determine as closely as possible the average actual cost to the company of making and maintaining a connection to a residence, including interest and depreciation on that equipment used solely by one customer and not available for any other customer. Then let us include the cost of bookkeeping, meter reading, etc., and possibly including the cost of magnetizing current. Then let each customer's bill have printed on it this sum as a "connection charge," irrespective of whether any current be consumed inside the house or not. The usual "minimum charge" may be eliminated, the cost per kw.h. lowered a little, and the customer may buy, and pay for, as little as a single kw.h. or as much as he likes. With this system it really makes but little difference in the cost to the company per kw.h., whether the customer uses 10 or 100 kw.h. per month. Of course there must be a reduced price for large consumption, and to take care of this reduction the "block system" now in use in several places seems at least one of the best methods. With the block system each customer of a given class pays a given rate for the first block, a less rate for the second block, a still less rate for the third block,

and so on. The method is quickly understood by the public and is well liked where used.

For a householder whose use of electricity is not mainly for lighting, it now seems to be the general practice to install a second meter, and charge a different rate. Perhaps that is the most satisfactory thing to do at present.

It seems to the writer that the effort in apportioning charges among various classes of industrial consumers should be to make each class pay as nearly as possible the same rate of return to the company on such part of the company's plant and working staff as serves the particular class considered. Proper weight, however, must be given to the value of the service to the consumer, and to the price that the consumer can afford to pay. Certain classes of users may be able to pay more than other classes for a kw.h. consumption that may cost the company the same in either case. Such differences in value of service should be considered, as well as differences in cost to supply service. The writer also believes that generally speaking, too much attention is given to total consumption in kilowatt hours, and too little attention is given to load factor, and especially to the shape of the load curve, and that far too little attention is given to classes of load that may exist, or may be developed, and may be kept almost wholly off peak. It should be noted that a customer with an irregular load curve, but who is wholly off peak, will probably be more desirable, at least on an extensive system, than a customer with 100 per cent load factor.

The writer would favor the block system of charging in nearly all cases, and, where the size of the bill would justify it, would like to see a maximum-demand meter used. In that case a possible arrangement of blocks and of bills might be something as follows: (the figures are used for illustration only):

Form of Bill.

Consumption for month: K.W.H. Month of.....
7320 KW. hours. Days, 30. Maximum demand 96. Product 2880

2880 KW..H	@ 5c	$144.00
2880 KW.H.	@ 2½c	72.00
1560 KW.H.	@ 2c	31.20
7320 KW.H.	for total sum of	$247.00

The preceding bill is for a customer having a monthly total load factor of a little under 10 per cent. For the same total consumption but a better load factor we may assume additional illustrative rates and construct a bill as follows:

Form of Bill.

Consumption for month: K.W.H. Month of.....
7320 KW. hours. Days, 30. Maximum demand 38. Product 1140.

1140 KW.H.	@ 5c	$ 57.00
1140 KW.H.	@ 2½c	28.50
1140 KW.H.	@ 2c	22.80
1140 KW.H.	@ 1¾c	19.95
1140 KW.H.	@ 1½c	17.10
1140 KW.H.	@ 1¼c	14.25
480 KW.H.	@ 1c	4.80
7320 KW.H.	for total sum of	$164.40

The preceding forms, of course, are simply equivalent to combining the block system with the method already used rather extensively of charging a rate depending upon the "hours use of maximum demand."

A rate-fixing commission should meddle as little as possible with such rate details as have been mentioned under the present heading, although a commission should be ready to advise upon such matters at the request of any company.

DISCUSSION—TURBINE AND BOILER EFFICIENCIES.

The papers of the evening were by R. F. Chevalier and Robert Sibley, on the subject of "Turbine and Boiler Efficiency Tests in Oakland," a copy of which appeared in the Journal of April 6, 1912.

At the conclusion of the delivery of the papers the following discussion was had:

Clem Copeland: The rating of these turbines were based on the 80 per cent power factor. Can anybody tell just why that is?

Robt. Sibley: The turbine at Station C in Oakland is rated at 15,000 kilovolt amperes. Therefore with an 80 per cent power factor, we considered it as a 12,000 kilowatt turbine.

Clem Copeland: I thought the rating was 15,000 kilovolt amperes and not 15,000 kilowatt capacity.

Robt. Sibley: The one in Oakland is 12,000 kilowatts; in San Francisco 15,000 kilowatt capacity at Station A.

C. E. Gaines: I would like to ask Mr. Sibley about the electrical measuring instruments, that is, what current and tension transformers did you use, and were these meters calibrated with these particular transformers before and after the test, and if there were any other instruments on the meter transformers during the test?

W. J. Davis Jr.: The measuring instruments were calibrated with their own particular transformers.

L. R. Jorgensen: Following the many interesting features of the installation shown in the pictures I have seen a detail which I do not quite understand. On the Parker boiler—which seems to be an excellent piece of apparatus—the manhole covers, or handhold covers, cannot be taken out except by breaking a tube. That seems to me not a good feature and could be remedied.

R. F. Chevalier: There is a manhole in the front end of the drum, and this is of standard design and can be removed easily. The handhole covers have metal to metal seats and require no gaskets. The joint is made from the inside, so that advantage can be taken of the pressure coming against the plate and joint, thus taking the strain off of the bolt and spider. These plates are circular in design so as to facilitate grinding in event of scoring the seats and also to remove any rust that may accumulate during a cleaning period. Owing to this design it is necessary to make the plates smaller than the outside diameter of the tubes so as to enable placing them in each header before inserting the tubes.

L. R. Jorgensen: That is a bad feature about it.

R. F. Chevalier: It is a bad feature if you have to remove the handhole plates, but as it has proven, it is rarely necessary to do so.

H. W. Crozier: I should like to ask Mr. Chevalier, is there anything gained, or any special reason why the circulation in the Parker boiler is down for the water as it is heating? As I understand, the water comes at the highest point, and the circulation is gradually down towards the hotter fire. That seems to be contrary to most of the laws of the circulation of water, and in most other types of boiler I believe the circulation is up as the water heats to allow the less condensed water to rise, and at the same time the temperature in the tubes is less. In this case the circulation is down, and you are therefore forcing the water against its natural direction of circulation. Is there any reason for that or explanation of that?

R. F. Chevalier: There is a reason. The inventor of the boiler, Mr. J. C. Parker, realized that if it were possible to design a steam generator so that the feed water entered that part where the gasses were coolest. then causing this water to flow down through the tubes so that the heating surfaces containing the hottest water and steam would be in contact with the hottest gases, the maximum transference would be realized. Such data as have been obtained show that this theory is evidently correct. It will be remembered that the escaping gases from the boiler during the efficiency test averaged 370

degrees F. The temperature of the saturated steam corresponding to the pressure was 382 degrees F. This condition could hardly exist—and besides would result in a loss of efficiency—were it not for the fact that the feed water enters and flows through the tubes comprising the heating surface in the last pass of the boiler, and that the temperature of this water is much less than that of the steam. The temperature of the escaping gases in the capacity test averaged 440 degrees F.—the boiler was operating at 175 per cent of the builder's rating, evaporating 6.46 pounds of water from and at 212 degrees F. per square foot of heating surface. I have searched over considerable reliable data on evaporative tests with oil fuel, and in no instances have I found records of such low temperatures of escaping gases when the boilers were operating at a corresponding rating.

Question: Have they found it necessary to put on those non-return valves?

R. F. Chevalier: The non-return or check valves are necessary in order to force the circulation of the water downward, although there have been instances where the boiler was operated without any valves. Personally I know of an occasion where an engineer had removed the checks from two 150 h.p. boilers. These boilers operated a year without any checks, and the only difference that was noted was the increased amount of scale and dirt that was deposited in the tubes.

L. R. Jorgensen: It seems that the lower tubes must act like a superheater also.

R. F. Chevalier: No definite data, to my knowledge, has ever been secured whether or not the bottom tubes superheat the steam. If such is the case it would occur when the boiler is operating at a high rate of evaporation, and the superheat would disappear when the steam is discharged from the upcast tubes into the drum and comes in contact with the saturated steam and water from the other tubes. When a boiler is operating below the rating for which it was designed, there is evidently considerable water in the lower tubes. The proof of such being the case is that thin scale is found deposited in the lower rows. It would be an easy matter to attach a calorimeter to an upcast from the bottom tubes, and thus determine the proportion of steam and water discharged by these tubes providing not too great a quantity of water was entrained.

H. W. Crozier: I would like to ask a couple of questions about the cleaning of these boilers. I understand that in the same station, in addition to the Parker boilers there are boilers of other water tube types, which of course collect scale in the tubes. Now, does the Parker boiler collect scale at the same rate or the same amount of scale in the tubes as the others? If it does, how often is it cleaned? And the third question is about the caps, grinding them in. Will you give us some idea of how much time it takes and how much it costs to grind in a set of caps? One boiler is extensively advertised on account of the fact that it has no caps to grind in.

R. F. Chevalier: As yet the boilers at this plant have not been operated long enough to make any comparison between them as to the difference in the amount of scale or incrustation deposited in the inner surfaces. Scale and dirt accumulate in the tubes of this type of boiler less than in those of any other type, and owing to the rapid circulation of water within the lower elements, the tubes of these remain comparatively clean. Owing to this fact it is not necessary to clean the boiler as often as other types. Removing the mud and scale from the drum is sufficient cleaning to take care of most of the deposit from the feedwater for a considerable period of time. The boiler that was under test had been operating from six to eight weeks intermittently, and prior to the test some of the caps were removed from both the steaming and feed elements. It was found that the tubes of the latter had a slight deposit of soft slush about 1/16 of an inch in thickness. The tubes in the steaming element were perfectly clean and free from dirt, and appeared the same as the day that they were placed in the boiler. I have under my supervision two boilers of this type of about 200 h.p. each. These boilers furnish steam for a cannery, and the water is very bad for boiler use, depositing considerable scale. These boilers are operated throughout the canning season without being cleaned and are run very hard. At the end of the season when the boilers are opened quantities of scale and mud are taken from the drums. The tubes in the feed water element have from ½ to ¾ of an inch deposit. The tubes in the steaming element have some scale; but it stands to reason that if the lower tubes exposed to the fire were very dirty they would soon blister and burn out. I notice that different feed waters affect the location of deposits of scale. Some waters will deposit most of their scale forming matter in the first tubes of the feed element; others in the middle tubes of this element, and other waters in the last tubes. There is also always a deposit of scale and dirt in the drum. I have known instances where the scale and dirt were deposited in the first two or three upper tubes of the steaming elements, where the circulation is not as rapid as in the lower tubes, this occurring when the feed water is very bad. I have seen a boiler opened that had not been operated very hard and have found it dirty. The grinding in and setting of a handhole plate should not occupy more than two or three minutes by a skilled workman. The operation is very simple. The plate is so arranged that a special wrench is easily fitted so that a couple of twists is generally sufficient to make a tight joint.

H. W. Crozier: I mean the whole boiler?

R. F. Chevalier: I have no record of the time required to make up the joints on a whole boiler.

K. G. Dunn: I would like to ask Mr. Sibley what percentage of the available energy in the steam was converted into useful energy under actual operating conditions?

Robt. Sibley: On the 10,000 kw. load, 13.876 lb. of water were used per kw. hr. delivered at the generator terminals. This test was at 187.2 lb. abs. pressure and 150.65 degrees superheat. The steam was exhausted from the turbine blades into the condenser, maintaining a vacuum of 28.229 in.

I find in reference to chart No. 1 in Marks & Davis' Steam Tables that the total heat of steam at 187.2 lb. abs. and 150.65 degrees superheat is 1281 B.t.u. Assuming perfect adiabatic expansion through the turbine stages into the condenser, I find also from this chart, that the total heat of the steam entering the condenser at 28.22 in. vacuum or .87 lb. abs. pressure, is 910 B.t.u. Hence there are available under ideal conditions, a total of 371 B.t.u. of energy to perform useful work. Since 1 kw. hr. represents (2645 × 1.34) B.t.u. of energy I find the efficiency to be.

$$\text{efficiency} = \frac{2645 \times 1.34}{371 \times 13.876} = 68.9 \text{ per cent.}$$

In actual practice this efficiency will of course be slightly less.

W. J. Davis, Jr.: This particular turbine utilizes about 68.5 per cent of the available energy in the steam according to the Rankine cycle.

K. G. Dunn: This efficiency should be given because operating conditions vary, and the different showings of pounds of steam per kilowatt hr. do not necessarily indicate the economy of the unit itself, because it might be under high vacuum, and another operating under less favorable conditions.

Robt. Sibley: I think the ratio should be given on a different basis, in other words, on a thermal basis. I find a great many turbines are now beginning to be sold under this new guaranteed condition.

W. J. Davis, Jr.: While it is of great interest to the designing engineer to know the Rankine efficiency of his turbine, it is of no particular practical interest to the operator, for the reason that different types of turbines have different operating characteristics. One type of turbine may operate well at high superheat and at low vacuum, whereas another type may not; and consequently if each type is placed on the same basis as

regards superheat, steam temperature and vacuum, full advantage is not taken of the peculiarities of each type in working through these wide temperature ranges.

K. G. Dunn: I would like to ask Mr. Davis what type of turbine operates best at low vacuum?

W. J. Davis, Jr.: The impulse type, for the reason that in this type it is possible to employ peripheral speeds more than fifty per cent greater than it is possible to use in the reaction type. The increased peripheral speeds permit larger diameters, and consequently a larger discharge cross-sectional area for the steam in the last stage. The increased discharge area of the buckets in the last stage will permit a greater number of expansions within the moving elements of the turbine, and hence a more effective utilization of the available energy in the steam at the higher vacuums.

K. G. Dunn: You would use a constant correction factor for all changes of vacuum?

W. J. Davis, Jr.: The correction factor for changing vacuum is approximately a constant between 25 inches and 29 inches for constant load conditions and for any particular design of turbine.

On the larger turbines the correction for a Curtis turbine at or near full rated output between the limits mentioned, is approximately one pound of steam per kilowatt hour for a variation of one inch in back pressure. At half load the correction is approximately equal to one and one-half pounds of steam per kilowatt hour for each inch of variation in vacuum.

K. G. Dunn: The point I make is that the only basis of comparison would be on the basis of percentage of the available energy that the machine absorbs. You don't always get the same operating conditions. There is no turbine but what would gain by higher vacuum, and also by higher superheat; but you can go so far with the superheats that your total saving on station economy would not be as good as it would be with a lower superheat. It is a nice argument from the standpoint of the salesman to get a high superheat, but you can get that so high that your saving on station economy would be less than with a lower superheat.

W. J. Davis, Jr.: That is very true, but we must look a little further. The greatest advantage in the way of economy obtainable from the steam turbine is its ability to work through a very large temperature range. The efficiency of a reciprocating steam engine of the best design is higher than that of a steam turbine for the range through which it works, that is to say, it is possible to get a Rankine efficiency as high as 72 per cent with a reciprocating engine, as against 68 or 69 per cent with the turbine, but when we install the steam engine and the turbine so as to permit each to work under its own best conditions, the turbine will do better because it takes advantage of available energy which the reciprocating engine cannot reach. The best type of reciprocating engine cannot use the available energy in the steam where the vacuum exceeds 23 or 24 inches.

K. G. Dunn: I think you will find that the majority of steam engines do about twenty expansions. The highest economy of course would be in using steam through an engine down to approximately atmospheric pressure, which would be better than a turbine, and then using an exhaust turbine. When you stop to consider the investment charges and the maintenance charges that hardly works out so well. What I mean is this, in regard to the superheat only, what is the use of a turbine which will show a very low water rate on an excessively high superheat, if a station economy of a still lower water rate could be obtained by a lower degree of superheat? That is the point I am trying to make—the cost per kilowatt on the switch board gauge—not at generator terminals.

W. J. Davis, Jr.: In stations operating at 180 pounds gauge steam pressure, the use of 100 degrees F. superheat would be attended by an increase of approximately 4½ per cent in the fuel consumption. Steam so superheated will decrease the water rate on most Curtis turbines about eight per cent, from which it will be seen that there is a net gain of three and one-half per cent due to the use of 100 degrees superheat. The net economy to be obtained from a superheat of 150 degrees is bound to be approximately five per cent; and for this reason the present tendency in the larger and more modern power stations where load conditions are favorable is towards the increase of higher superheats. The Boston Edison Company and the Commonwealth Edison Company of Chicago are now working at 150 degrees F. superheat. While superheats exceeding 200 degrees are not unusual abroad, the tendency in the States is towards more conservative practice, due to the increased cost of installation and maintenance of steam piping, valves and so forth, required for the higher temperatures.

H. W. Crozier: What about your auxiliaries at these high superheats? Aren't you getting into packing troubles and other things which would be avoided by using somewhat less?

W. J. Davis, Jr.: Yes. All valves and fittings are more expensive, and require increased maintenance cost.

H. W. Crozier: Isn't it good practice to carry moderate superheat on account of the effect on the auxiliaries, that is, the cost of the packing and repairs that you have to do to the auxiliaries?

W. J. Davis, Jr.: Yes. Where under steady load conditions on the station a higher superheat may be carried than where the load is variable.

H. W. Crozier: I want to ask Mr. Chevalier a question about the steam performance of the boiler. Did that include the steam used by the burner?

R. F. Chevalier: In calculating the efficiency the steam used by the burner was not deducted from the total evaporation of the boiler, for this is a matter which concerns the fuel, type of burner and furnace, and should not be charged against the boiler when making a comparison on the performance.

H. W. Crozier: You consider that the steam used by the burner is a matter in regard to the fuel, and nothing whatever to do with the boiler?

R. F. Chevalier: If no steam were used for atomizing the weight of the escaping gases would be reduced, and there would consequently be less heat lost thereby. In this way there may be a very small gain by the boiler as a unit. However, commercially the net output of the boiler is what counts, and the amount of steam used to prepare any fuel for burning should be taken into consideration. With oil fuel the amount of steam required for atomization is quite an item of cost and varies with the type of burner, furnace arrangement and draft. I have data at hand on the amount of steam used by the burners on the efficiency test if you care to hear it.

H. W. Crozier: I would be very much interested.

R. F. Chevalier: The total steam used by the burners for eight hours was 5520 pounds. The total water actually evaporated was 205,277 pounds.

The total equivalent evaporation was 241,611 pounds.

$\frac{5520}{205277}$ equals 2.7 per cent of the total water evaporated.

$\frac{5520}{241611}$ equals 2.29 per cent of the equivalent evaporation.

$\frac{5520}{14979}$ equals .369 lb. of steam required to atomize 1 lb. of oil.

C. F. Braun: Returning to the question which was asked the author of the paper as to what advantages were derived by causing the water to circulate in a downward direction through the tubes, there is one point which was not touched upon and which is perhaps worthy of mention.

It is a generally accepted fact that the rate of transmission of heat between steam, gases or liquids through metal division

is proportional to the difference in temperature between the substances on each side of the hot surface. However, in a boiler the temperature of the substances themselves is not the same at all parts of the hot surfaces, for the temperature of the gases decreases in their course and the temperature of the water increases. Only one temperature value can be used in canculation, and that is the mean. For any given set, initial and final temperatures of the gases and of the water, the mean temperature difference will be greater if the heating gases and the water to be heated have opposite directions of flow. By constraining the water to flow downward while the gases travel upward this ideal condition of opposite flow is approached. The equation for mean temperature difference is

$$D_{mean} = \frac{d_1 - d_2}{\log_e \frac{d_1}{d_2}} \text{ where}$$

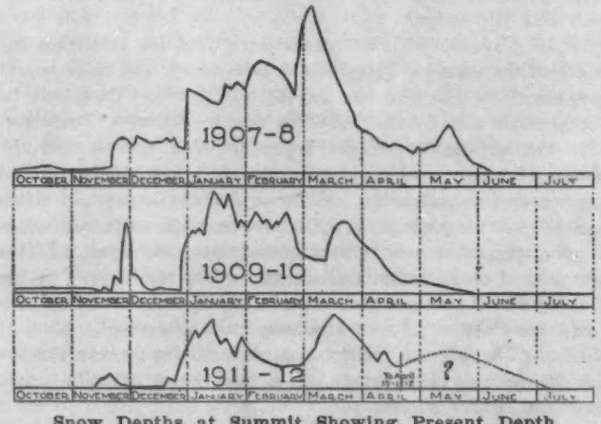
d_1 = the temperature difference between gases and water at commencement;

d_2 = the temperature difference between gases and water at the end.

By substituting any set of assumed values it will be readily seen that the mean difference is greater with counter flow, and it follows that the heat transmission per square foot of boiler surface is greatest.

THE PRESENT DEPTHS OF SNOW AT MOUNTAIN SUMMITS.

Much agitation has been felt among engineers of the Pacific Coast regarding the lack of snow in the Sierras, Cascades and Rockies for the present season.



Snow Depths at Summit Showing Present Depth Greater Than Any of the Three Lean Years Given.

Professor Alexander McAdie of the U. S. Weather Service has compiled the charts shown herewith, which definitely compare the present year with two other recent "lean" years. From this and other data in the office of the Weather Service the following snow-depths for various years have been ascertained:

	Depth of Snow at Summit.					
	1907	1908	1909	1910	1911	1912
April 1	240	50	188	65	135	50 inches
May 1	115	20	119	13	94	"
June 1	68	13	27	2	38	"

From this it is seen that no serious alarm may be felt over hydroelectric storage for the present season. In fact the snow depth now at Summit is as good if not better than the seasons of 1908 and 1910.

A NEW WATER CODE FOR WASHINGTON.

Washington will have the most practical advanced code of water rights and uses in the Union if the measure, to be submitted by a committee of 15 appointed by Governor Marion E. Hay at a conference in Spokane, April 18, is enacted by the state legislature at Olympia, next January. The plan is to harmonize the most beneficial features of the best codes of the various states, adapted to Washington, and formulate uniform laws that will have the effect of promoting development of all projects for the use of water and encourage capital and settlers.

Governor Hay, who was the first speaker at a meeting of irrigationists, water users and representatives of power development companies in the rooms of the Spokane Chamber of Commerce, where all parts of the state were represented, said he fully realized the importance of a practical water code, saying also that the present laws governing the water proposition in Washington are conflicting and utterly inadequate for either irrigation or power.

This committee was appointed on recommendation of E. F. Benson of Prosser and A. J. Ternant of Quincy:

Lachlan MacLean, Spokane; E. C. Burlingame, Walla Walla; William T. Clark, Wenatchee, and Arthur J. Shaw, Spokane, representing the water users; Prof. O. L. Waller, Pullman; C. H. Swagart, North Yakima, federal reclamation engineer in charge of the State of Washington; Joseph Jacobs, Seattle, engineer in charge of the Quincy Valley project; Marion Chase, Okanogan, irrigation engineer; Carroll B. Graves, Seattle; Ira P. Englehart, North Yakima; Ralph P. Williamson, North Yakima; Cyrus Happy, Spokane; Eugene W. Burr, North Yakima, attorney of the United States Reclamation Service, and L. K. Armstrong, Spokane, representing the irrigationists and David L. Huntington, president of the Washington Water Power Company, Spokane, representing the power companies.

The committee will meet several times during the year at Wenatchee, North Yakima, Spokane and other points in the irrigated belts. The idea is that if the proposed code meets with the approval of these centers of irrigation, when presented for passage by the legislature at its next session, it would have the support of the entire state, thus insuring its passage.

Professor Waller, who is thoroughly familiar with every phase of irrigation in the State of Washington and throughout the Northwest, said an owner of irrigated land in Washington cannot abstract a water title at present, adding that this bars the investment of capital in such enterprises and retards the development and settlement of the lands.

Others taking part in the discussion were: Eugene W. Burr of the reclamation service at North Yakima, H. R. Mann of the Loon Lake Irrigation Company, Stephen O. Jayne, Spokane, irrigation expert in Washington for the Department of Agriculture; Arthur J. Shaw, representing the D. C. Corbin irrigation interests in the Spokane Valley and William T. Clark, Wenatchee. Lachlan MacLean presided at the conference, the secretary being A. J. Ternant.

WESTERN LAWS OF ELECTRICITY AND WATER

LOSS OF WATER RIGHTS.

BY A. E. CHANDLER.

Water rights, like other real property, may be lost by abandonment, forfeiture, adverse user or prescription or estoppel.

Abandonment and Forfeiture.

Abandonment is often defined as "the relinquishment or surrender of rights or property by one person to another," but in the law of waters abandonment simply adds to the unappropriated public waters and the benefits therefrom are not intended to accrue to a particular person. It consists of the two elements, act and intention; although the latter is generally considered the "essence" thereof. As stated in Utt v. Frey (106 Cal. 397):

> The mere intention to abandon, if not coupled with yielding up possession or a cessation of user, is not sufficient; nor will the nonuser alone without an intention to abandon be held to amount to an abandonment. Abandonment is a question of fact to be determined by a jury or the court sitting as such.

The intention to abandon must be shown by nonuse and similar acts, but nonuse, unless continued for an unreasonable period, will not be sufficient. The presumption created by even an unreasonable non-use may be overcome by satisfactory proofs. The opinion of the Supreme Court of Montana in Smith v. Hope Mining Company (45 Pac. 632) is especially noteworthy as the water to run a mill had not been used for nine years but the machinery was cared for and maintained in good condition during the period of non-use. The Court said:

> It is true that the evidence shows without controversy that the Algonquin Company did not use the waters, in their mill or otherwise, for a period of about nine years following 1883. But mere nonuser of a water right is not abandonment.
>
> The nonuser of water for so long a period, and especially a period longer than the statute of limitations, is certainly very potent evidence, if it stood alone, of an intention to abandon. * * * But what ever force the fact of nonuser for nine years may have had in showing an intention to abandon, that force was wholly offset and contradicted by the other evidence in the case, so as to leave, in our opinion, not even a conflict of testimony.

As riparian rights to the use of water do not depend upon use nor cease with disuse, they cannot be lost by abandonment, so that this question can only be raised regarding rights by appropriation. Although water rights and ditches are generally thought of as one, they are distinct property interests and either may be held without the other. A ditch can accordingly be abandoned without abandoning the water right. Likewise water may be turned into natural water courses for diversion at lower points without it being held an abandonment—that is, the waterway may be used as part of the ditch system. It is also held without exception that the point of diversion, the place of use and the manner of use may be changed without loss of right, provided no other user is injured thereby.

As non-use under the court rulings simply raises the presumption of abandonment, a number of the western states have fixed by statute a definite period for which non-use will work a forfeiture of the right. The prescribed period in Utah is seven years; in Wyoming and Idaho five years; in New Mexico four years; in North Dakota and South Dakota three years; in Oklahoma two years; in Oregon one year. Both the Utah and Oregon statutes contain the added provision that a question of abandonment shall be one of fact, to be tried and determined as other questions of fact. The virtue of the two statutes is thereby destroyed as the aim of such statutes is to definitely fix the period of non-use which shall constitute a forfeiture and thus preclude court proceedings to determine the intention. The Supreme Court of Oregon in Hough v. Porter (98 Pac. 1083) recently said:

> The right to the use of water by nonuser alone cannot be deemed forfeited short of the period prescribed by the statute of limitation for real actions. Dodge v. Marden, 7 Or. 456. But such right may become extinguished by any act showing an intent to surrender or abandon the right, after which, if the person having the right ceases its use for one year, his interest is lost; but the facts essential to a forfeiture by this company are not established by the proof. The nonuse from 1893 to 1900 is shown; but this alone is insufficient. To constitute an abandonment of a water right, there must be a concurrence of the intention to abandon it and an actual failure in its use.

The leading California case on the question of forfeiture, or loss of right through non-use, and one much quoted in other jurisdictions, is Smith v. Hawkins (110 Cal. 122). The court therein distinguishes between abandonment and forfeiture, and on account of its importance the following long quotation is given:

> Section 1411 of the Civil Code declares that the appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such purpose, the right ceases. This section deals with the forfeiture of a right by nonuser alone. We say nonuser, as distinguished from abandonment. If an appropriator has, in fact, abandoned his right, it would matter not for how long a time he had ceased to use the water, for the moment that the abandonment itself was complete his rights would cease and determine. Upon the other hand, he may have leased his property, and paid taxes thereon, thus negativing the idea of abandonment, as in this case, and yet may have failed for many years to make any beneficial use of the water he has appropriated. The question presented, therefore, is not one of abandonment, but one of nonuser merely, and, as such, involves a construction of Section 1411 of the Civil Code. That section, as has been said, makes a cessation of use by the appropriator work a forfeiture of his right, and the question for determination is, How long must this nonuser continue before the right lapses?
>
> Upon this point the legislature has made no specific declaration, but, by analogy, we hold that a continuous nonuser for five years will forfeit the right. The right to use the water ceasing at that time, the rights of way for ditches and the like, which are incidental to the primary right of use, would fall also, and the servient tenement would be thus relieved from the servitude.
>
> In this state five years is the period fixed by law for the ripening of an adverse possession into a prescriptive title. Five years is also the period declared by law after which a prescriptive

right depending upon enjoyment is lost for nonuser; and for analogous reasons we consider it to be a just and proper measure of time for the forfeiture of an appropriator's rights for a failure to use the water for a beneficial purpose.

In the preceding article it was stated that under the doctrine of prior appropriation one is given a reasonable time after the completion of the diversion works in which to apply the water claimed to beneficial use. In the case of an irrigation project this application requires a number of years which is definitely fixed in those states where appropriations are made by application to the State Engineer, but which, in states like California where the posting of notices is still tolerated, is limited only by the rule of reasonable diligence. This time limit for the larger projects has seldom been passed upon in the reported cases. The five-year period fixed in Smith v. Hawkins must not be taken as a precedent in cases of incomplete appropriations as in the latter the right to the full amount of the appropriation is conditioned upon the irrigation of all the land under the ditch within a reasonable time. Smith v. Hawkins deals with a right which had become completely vested and later fell into disuse. It is believed that the larger irrigation projects will be allowed a longer period than five years in which to apply all the water to beneficial use as the settlement of such generally necessitates a greater time.

Adverse Use of Prescription.

These are a very few cases involving the alleged wrongful divrsion of water in which a right by adverse use or prescription is not pleaded. Nevertheless there are very few cases in which such title is upheld, as it is seldom that a case presents all the elements necessary to prove adverse use. In order to ripen into title the adverse use must be continuous for the statutory period, open, notorious, peaceable, under claim or color of right, and to the damage of the water-user against whom the right accrues. The burden of proof is on the claimant of the adverse title.

The statutory period referred to is the period provided in the statute of limitations regarding actions pertaining to real property. The period for the western states is as follows: Arizona, three years; California, Colorado, Idaho and Nevada, five years; Utah, seven years; Montana, Nebraska, North Dakota, Oregon, Texas, Washington and Wyoming, ten years; Kansas, fifteen years; South Dakota, twenty years. By "continuous" is not meant that the use should be unceasing for the period, but simply that the claimant used the water during such times as he needed it. In the case of irrigation the water might be needed but one day during each month of the irrigation season, and such use if made for the statutory period would be held "continuous."

"Open" and "notorious" signify that the use has not been by stealth but on the contrary "before all the world," so as to be generally known. "Peaceable" (or "interrupted") means that the original possessor of the right has not interfered with the adverse use. Any interference or interruption, however, slight, will prevent the acquisition of the right. Mere verbal protests, however, are not considered interruptions—the latter must be due to some physical act, such as closing down a headgate, cutting a ditch bank, or breaking a diversion dam.

The claimant must consider and treat the right as his own and not acknowledge a superior claim on the part of the original owner. If at any time during the statutory period permission to divert the water has been sought, the adverse claim must fail.

That the use has been to the damage or detriment of the original possessor is generally the most difficult of the many points to prove. So long as there is sufficient water in the stream for both no such damage can result. This point is especially difficult when the adverse use is being claimed against a lower riparian owner. As such an owner does not have to use the water, no one knows what stream depletion —short of the diversion of the entire flow—will be of detriment. The problem was quite the other way in the early California cases where the riparian owner sought to enjoin an upper appropriator. In Heilbron v. Fowler Switch Canal Co. (75 Cal. 426) the company, an appropriator, claimed that its diversion would result in no appreciable injury to the plaintiff's land—a Spanish grant. Although the following quotation does not present other and very material facts upon which the court based its injunction, it shows the "one-sidedness" of the struggle between riparian owners and appropriators:

> **The injury is one, also, which in its nature cannot be estimated. In the recent case of Heilbron v. Last Chance Company it was said: "The flow of the water of a stream, whether it overflow the banks or not, naturally irrigates and moistens the ground to a great and unknown extent, and thus stimulates vegetation, and the growth and decay of vegetation add, not only to the fertility, but to the substance and quantity of the soil."**
>
> **If this be so,—and it cannot be doubted—it is obvious that in a climate like that where this land is situated, the benefit derived from a flow of water for thirty miles along its boundary, and ten miles through it, cannot be inconsiderable, but yet the extent of benefit must ever be an unknown quantity.**
>
> **The defendant here states that the channel of the river above and along this land is deep, and therefore at times of ordinary flow the seepage cannot be great. If so, it must be important to plaintiffs that the channel should carry a full stream, and evidently at such times the percolation would be increased.**

It is clear from the above that, unless the attitude of the court be changed, the riparian owner can easily show sufficient damage to secure an injunction, but the problem before the appropriator of showing sufficient damage to justify a finding of adverse use is far different. As stated the only case which is certain is where the appropriator has continuously diverted the entire low water flow. Regarding the damage as between appropriators Judge Hawley in Union Mill & Mining Company v. Dangberg (81 Fed. 73) said, "There must have been such a use of the water, and such damage, as would raise a persumption that complainant would not have submitted to it unless the respondents had acquired the right to use it."

The idea is current in California that use by an appropriator for the statutory period—five years—gives an absolute right as against lower riparian owners. As indicated above, the water must not only be used but it must be used adversely, so that the current view is far from correct.

It should be apparent to all that an appropriator can secure no adverse title against an upper riparian

owner, but cases are constantly arising where this plea is made. In Rogers v. Overacker (4 Cal. App. 333) the California Supreme Court in dealing with such a plea said:

The rule seems to be as laid down in Bathgate v. Irvine, 126 Cal. 135, 77 Am. St. ep. 158, 58 Pac. 442, and Hargrave v. Cook, 108 Cal. 72, 41 Pac. 18, 30 L. R. A. 390. In the first case it was said, approving the latter case, that a lower riparian owner cannot acquire a right, either by prior appropriation or by prescription or adverse user, as against an upper riparian proprietor whose rights antedate the appropriation and user, and the mere nonuser of the water by the upper proprietor and his permitting the water to pass down to the lands of the lower owner cannot make the user of the lower owner adverse or strengthen his claim of appropriation or prescription.

The expression "as against an upper riparian proprietor whose rights antedate the appropriation and user" refer to the well settled rule that the rights of the appropriator are superior to those of the riparian owner where the former had initiated his appropriation while the riparian land in question was unentered public land. Occasionally, even in the reported cases, the rights of the appropriator are considered superior if initiated before patent issued for the riparian land. The present accepted view is, however, that the riparian owner's rights date from his entry of the land and not from the issuance of patent, and, therefore, to be superior, the appropriator must have initiated his rights to the land.

Estoppel.

"Estoppel by silence" arises where a person who by force of circumstances is under a duty to another to speak refrains from doing so and thereby leads the other to believe in the existence of a state of facts in reliance upon which he acts to his prejudice (16 Cyc. 681).

Although the general principles of appropriation are understood by those diverting, or intending to divert, water and especially the rule that the subsequent appropriator takes only what is left, it is very common to have the claim made that no notice of the rights of the opposing party was given and that said party is estopped from setting up a superior right. The courts very early in the mining period expressed themselves strongly to the contrary but the claim still persists. In a recent California case dealing with underground waters it is said:

The mere fact that the defendants expended money in sinking the wells and putting in the pumps each upon his own land, with the knowledge of the plaintiffs and without objection by them, creates no estoppel. A mere passive acquiescence when one is under no duty to speak does not raise an estoppel." (Verdugo Canyon Water Company v. Verdugo 152 Cal. 655).

Practically the same language has been used in a number of cases where the point was raised. It is therefore established beyond doubt that neither a riparian owner nor an appropriator need serve notice of existing rights upon a subsequent appropriator engaged in the construction of diversion or storage works.

Rights of Way by Prescription.

Rights of way for ditches may be acquired by prescription in the same way as water rights. The most serious element in so proving is the "color of title." After a ditch has been constructed and operated for years it is very difficult to show that the right does not rest upon permission to occupy given by the owner of the land crossed—that is, parol license. The statute of frauds provides that interest in real property can be conveyed only by written instruments. As a ditch right of way is such an interest, the original and strict legal rule is that the right cannot be founded on a parol license; but the rule has been modified, if not reversed, in a great many of the states.

In the very recent case of Gustin v. Harting (121 Pac. 522), decided Feb. 17, 1912, the Supreme Court of Wyoming considered at great length the question as to whether the plaintiff had acquired a right of way for a flume by prescription and also the right to maintain it under an irrevocable license—it being admitted that the flume had been constructed with the parol consent of the landowner, the defendant. It was held that, under the existing facts, the license was irrevocable and the right to maintain the flume secured by prescription. In reaching its conclusion the Court said:

The principle that a parol license, when executed by the expenditure of money or labor, if not given for a mere temporary purpose, becomes irrevocable, has been recognized and applied in several other cases involving irrigating works.

Among the many cases cited and examined in support of the principle are some from California Colorado, Nebraska and Oregon, showing that they also recognize the modified rule. To these Utah may be added.

The Supreme Courts of Montana and Washington refuse to accept the modified rule. In Archer v. Chicago M. & St. P. Ry. Co. (108 Pac. 571), decided April 2. 1910, the Supreme Court of Montana considered cases in favor of the new rule but held that, "sound * * * reasoning sustains the rule that a parol license of the character of the one under consideration is always revocable at the pleasure of the licensor."

ELECTROLYTIC SEWAGE TREATMENT

The electrolytic process for deodorizing sewage and destroying the disease germs which flourish in it has been adopted by the municipality of Santa Monica, Cal., and is reported to have proven a success, this enterprising city having ordered a second plant after a six months' test.

The plant was installed at Santa Monica in 1908 at a cost of $10,0000 and treats 550,000 gallons every twenty-four hours. The total cost of operation is $400 a month, but the greater part of this is for pumping, which is made necessary in this case by the lay of the land, and for the services of two men to care for the pumping outfit.

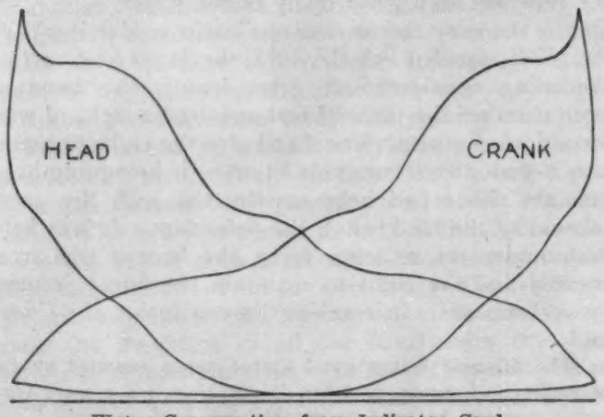
The plant is installed under the street at the shore end of the municipal pleasure pier, and its efficiency in removing all trace of odor from the sewage is indicated by the fact that no complaint is made by the thousands of people who frequent the pier or by the business men and residents in the vicinity, although the sewage is constantly flowing through the open troughs in the room under the street and thence discharging into the Pacific at the outer end of the pier, 1,600 feet from the shore.

SOLUTIONS OF THERMOTWISTERS.

WATER CONSUMPTION FROM INDICATOR CARD—NINETEENTH LECTURE.

BY W. S. HEGER AND ROBERT REID.

1. The indicator card given below is that of a simple engine of 12 in. stroke, 12 in. piston diameter, 1⅛ in. piston rod diameter and 235 r.p.m. The scale of the highest pressure shown on the card is 80 lb. gauge. What is the indicated water consumption per hour, without making allowance for the piston rod diameter?



Water Consumption from Indicator Card.

For the purpose of solution, the clearance was assumed to be 10 per cent of the stroke at each end.

The best place to make the above determination is at about 2/3 of the stroke, therefore p is drawn there and the following are scaled from the card:

$p = 40.4$ lb. abs. $\quad b = 7.94$ in.
$P_b = 16.3$ lb, abs. $\quad x = 5.35$ in.

From the steam tables,

$w = .09463$ lb. per cu. ft.
$w_1 = .04129$ lb. per cu. ft.

Clearance $c = 1.2$ in.

$W = 60\,N\,a\,[w\,(c + b - w_1\,(c + x)\,]$
W = Weight of water per hour.
$N = 2 \times$ r.p.m.
a = Area of piston in sq. ft.

$$W = 60 \times 2 \times 235 \times .7854 \left[.09463 \frac{(1.22+7.9)}{12} - .04129 \frac{(1.2+5.35)}{12} \right]$$

$\therefore W = 1095$ lb. per hour.

In finding the indicated horsepower it is first necessary to find the mean effective pressure and this can be done most accurately in this case (since the area is very irregular) by using Simpson's Rule to get the area:

$A = h/3\ (A + 4\,B + 2\,C)$

Where

A = Sum of 1st and tenth ordinates.
C = Sum of other odd ordinates.
B = Sum of even ordinates.

By dividing the card into 10 equal parts gives:

$$A_h = \frac{1.2}{3}\,(885) = 354 \text{ sq. in.}$$

M.E.P. = area/total length of card.

$$= \frac{354}{12} = 29.5 \text{ in.}$$

$$A_c = \frac{1.2}{3}\,(885.9) = 354.5 \text{ in.}$$

Av. M.E.P. = 29.51 lb.

$$\text{H.P.} = \frac{\text{PLAN}}{33000} = \frac{29.51 \times 1 \times 144 \times .7854 \times 235 \times 2}{33000} = 47.4 \text{ h.p.}$$

$$\text{Water consumption /I.H.P.Hr.} = \frac{1095}{47.4} = 23.12 \text{ lb.}$$

2. Compute the indicated water consumption per hour, making full allowance for piston rod displacement.

Head End Computation.

Area of piston = a = .7854 sq. ft.
P = 38.2 lb. abs.
W_p = weight of steam per cu. ft. at 38.2 lb. = .0913 lb.
P_b = back pressure = 16.52 lb. abs.
W_b = wt. of steam at 16.52 lb. = .04167 lb.
c = clearance = 0.1 ft.
b = dist. of P from beginning of stroke = .581 ft.
N = No. of strokes per min. = 235.
W = indicated water consumption per hour.
x = dist. the pt. of comp. from beg. of for. stroke = .3 ft.

$W_h = 60\,N\,[W_p a\,(c + b) - W_b a\,(c + x)]$
$W_h = 60(235)[\,(.0913)(.7854)(.681 - (.4167)(.7854)(.4)\,]$
$W_h = 14100\ (.0488 - .0131) = (14100)\ (.0357)$
$\therefore W_h = 503$ lb. water per hour (Head End).

Crank End Computation.

Area piston rod = .00694 sq. ft.
$\therefore$ A (crank end) = .7785 sq. ft. x = .404 ft.
Other values the same as for Head End.

$W_c = 60\ (235)\ [\,(.0913)(.7785)(.681) - (.04167)(.7785)(.504)\,]$
$W_c = (14100)\ (.0484 - .0163) = (14100)\ (.0321)$
$\therefore W_c = 452$ lb. water per hour (Crank End).
Total consumption per hour = 958 lb.

Steam Turbine Efficiencies—Twenty-first Lecture.

BY H. E. SANDOVAL AND U. S. ATTIX.

1. (a) A steam turbine operates under 200 lb. absolute pressure and ½ lb. abs. vacuum. Compute the Rankine and Carnot efficiencies, the entering steam being dry.

Formula:

$$\text{Rankine efficiency} = \frac{H_1 - H_2 + (n_2 - n_1)\,T_2}{H_1 - h_2}$$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1}$$

H = total heat.
h = heat of liquid.
n = entropy.
T = absolute temperature.

Computations:

Data from Marks & Davis' Steam Tables.

$p_1 = 200$ lb.. $\quad T_1 = 381.9 + 459.6 = 841.5$ degrees.
$H_1 = 1198.1 \quad n_1 = 1.5456$
$p_2 = .5$ lb. $\quad T_2 = 79.68 + 459.6 = 539.3$ degrees.
$H_2 = 1094.6 \quad n_2 = 2.0339 \quad h_2 = 47.7$

$$\text{Carnot efficiency} = \frac{841.5 - 539.3}{841.5} = \frac{302.2}{841.5}$$

$= 35.9$ per cent.

Rankine efficiency

$$= \frac{1198.1 - 1094.6 + (2.0339 - 1.5456)\ 539.3}{1198.1 - 47.73}$$

$$= \frac{103.5 + .4883\ (539.3)}{1150.40} = \frac{367.3}{1150.4}$$

$= 31.9$ per cent.

(b) entering steam has 10 per cent moisture.

BY GEO. M. SIMONSON AND D. L. BABCOCK.

Solution.

From Marks & Davis' Steam Tables using their notation, we have:

$p_1 = 200$ lb. abs.	$p_2 = 0.50$
$h_1 = 354.9$	$n_2 = 48.03$
$L_1 = 843.2$	$L_2 = 1046.7$
$H_1 = 1198.1$	$H_2 = 1094.8$
$n_1 = 1.5456$	$n_2 = 2.0330$
$T_1 = 381.9 + 459.6$	$T_2 = 80.0 + 459.6$
$= 841.5$ degrees abs.	$= 539.6$ degrees abs.
$x = 90$ per cent.	

Computations for Rankine efficiency.

$$\text{Useful energy, } E = H_1 - H_2 + (n_2 - n_1)\,T_2 \frac{L_1}{T_1}\,(1 - x_1)$$

$$(T_1 - T_2) \ldots\ldots (2)$$

$$E = 1198.1 - 1094.8 + (2.0330 - 1.5466)\ 539.6\ \frac{843.2}{841.5}$$

$$(1 - .90)\ (841.5 - 539.6)$$

$E = 103.3 + 263.0 - 30.25$
$E = 336.05$ B.t.u.

Total heat supplied $= h_1 + x_1 L_{t_1} - h_2$
$= 354.9 - .90 \times 843.2 - 48.03$
$= 1065.75$ B.t.u. supplied.

$$\text{Rankine efficiency} = \frac{336.05}{1065.75} = 31.53 \text{ per cent.}$$

$$\text{Carnot efficiency} = \frac{T_1 - T_2}{T_1}$$

$$= \frac{841.5 - 539.6}{841.5} = \frac{301.9}{841.5} = 35.88 \text{ per cent.}$$

Turbine Losses and Their Study—Twenty-Second Lecture.

BY A. F. BRIDGE.

Steam is delivered to a turbine at 180 lb. abs. and 100 degrees superheat. The condenser pressure is 0.5 lb. abs. Determine the energy in each pound of steam leaving the nozzle, assuming a loss of 10 per cent in the nozzle due to friction.

Consulting the Heat-Entropy Diagram which accompanies the Marks and Davis tables we obtain the following data-steam under the conditions given above (180 lb. and 100 degrees superheat) has a total heat content of 1254 B.t.u. Since the entropy is constant we follow the vertical line to its intersection with the 0.5 lb. pressure line, obtaining 874 B.t.u. as the total heat in the steam at exhaust. The heat drop is then $= 1254 - 874 = 380$ B.t.u. In the absence of such data, it is assumed that this is a single stage turbine of the pure impulse type. Since only 90 per cent of the original energy of the steam is available at exit from the nozzle due to friction loss therein we have—energy per lb. at point of leaving nozzle $= 380 \times 0.9 = 342.0$ B.t.u., or converting into mechanical units $= 342 \times 778 = 266070$ ft. lb. of steam.

Under the conditions of the problem the total energy in the steam issuing from the nozzle is therefore 266,076 ft. lb. of steam.

2. The nozzle makes an angle of 20 degrees with the moving blades in the above turbine and the steam leaves at a relative angle of 30 degrees. Assuming five stages of expansion and that the blades move with a velocity of 500 ft. per sec., what is the steam to bucket efficiency?

BY H. T. CARLTON.

From Molier diagram as given in steam tables of Marks and Davis.

Quality of steam $=$ 78.8 per cent.
Total heat (180 lb. and 100 degrees superheat) $=$ 1255 B.t.u.
Total heat (.5 lb. abs.) $=$ 870 B.t.u.

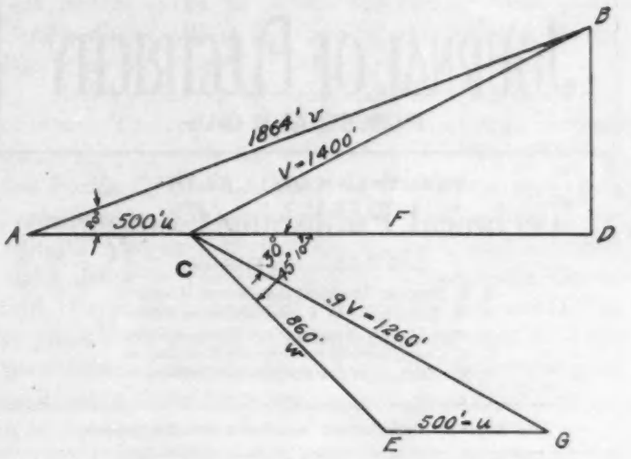
Heat drop $=$ 385 B.t.u.

$$\frac{385}{5} = 77 \text{ B.t.u. drop per stage.}$$

Entering velocity $V = 212.42 \sqrt{77} = 1864$ sec. ft

In the following it is assumed for simplicity that there is only one rotating blade per stage. The steam to bucket efficiency of the first stage is there computed as follows:

In the figure, AC is laid off to scale equal to 500 ft., which is the velocity of the rotating blade. AB is next laid off equal to the velocity of the impinging steam from the nozzles, which makes an angle of 20 degrees with AC as shown. Completing the vector diagram, BC is found to scale 1400 ft., which is the velocity of the steam along the surface of the rotating buckets. This velocity gradually diminishes due to friction and leaves the rotating vane usually in magnitude equal to 9/10 of V or in this case 1260 ft. per sec., forming an angle of 30 degrees as given in the problem. Completing a vector diagram, we find CE measures 860 ft. per sec., making an angle of 45 deg. 10 min. with AC. The entering steam, then, forces the wheel ahead by the component



Turbine Velocity Diagram.

$$AD = AB \cos 20°$$

And as the steam leaves a backward reaction is felt in amount of

$$CF = CE \cos 45° 10'$$

Each pound of entering steam possesses an inherent energy of $778 \times 32.2 (H_1 - H_2)$ ft. lb. and this gives up energy to the rotating buckets of $u (v \cos \alpha + \omega \cos \beta)$ ft. lb.

$$\therefore \text{efficiency} = \frac{u (v \cos \alpha + \omega \cos \beta}{778 \times 32.2 (H_1 - H_2)}$$

$$= \frac{500 (1864 \cos 30° + 860 \cos 45° 10'}{778 \times 32.2 \times 77}$$

$$= \frac{500 (1864 \times .940 + 860 \times .706)}{778 \times 32.2 \times 77} = \frac{1,179,000}{1,929,000} = 61.1\%$$

3. What should gauges read, if inserted at each of the above stages of expansions?

BY DAVID L. CLEMENT AND W. S. VAN WINKLE.

In solving this problem the Mollier diagram, as given in Steam Tables of Marks & Davis, was used to determine the total heat in the steam at the initial and final conditions.

At 180 lb. per sq. in. abs., Bt.u. value $=$ 1254.3
At 0.5 lb. per sq. in. abs., B.t.u. value $=$ 873.0

Total heat drop..... 381.3 B.t.u.

Assuming that the heat drop is equal in each stage, which is very nearly so, we have a drop of $381.3 \div 5 = 76.26$ B.t.u. per stage.

The B.t.u. value at the entrance to each stage is now determined.

1st stage, 1254.3 B.t.u.
2d stage, $1254.3 - 76.26 = 1178.04$ B.t.u.
3d stage, $1178.04 - 76.26 = 1101.78$ B.t.u.
4th stage, $1101.78 - 76.26 = 1025.52$ B.t.u.
5th stage, $1025.52 - 76.26 = 949.26$ B.t.u.

Reading on the constant entropy line of the Mollier diagram we find the pressures corresponding to the B.t.u. values given above.

1st stage, 180 lb. per sq. in.
2d stage, 76 lb. per sq. in.
3d stage, 27 lb. per sq. in.
4th stage, 8.8 lb. per sq. in.
5th stage. 2.4 lb. per sq. in.
Condenser, 0.5 lb. per sq. in.

In order that gauge pressure may be properly indicated, 14.7 lb. must be subtracted from each of the above readings. As the last three readings will then read negative values, it is customary to convert this into inches of mercury vacuum.

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Present Supply of Snow in the Sierras

The delightful rains of the week have added smiles to the face of the farmer and upon the hydroelectric power plant manager a somewhat eased countenance is observed. Even without the recent rains and snowfall, however, contrary to the pessimistic forecasts of many, the present depth of snow at Summit is greater than two recent years, notably the seasons of 1908 and 1910. Records of the depths of snow and rain have been maintained at the point named since 1870 through the co-operation of the Southern Pacific and the Weather Bureau. The station is the highest on the railroad, the culminating point in the long stretch of snowsheds, some 40 miles in all, so well known to travelers on the overland route, between Truckee and Blue Canyon. The elevation of the station is 7,012 ft. above sea-level.

On another page of this Journal will be found the seasonal profile of the depth of snow at Summit, as traced thus far, compared with the two "lean" years above alluded to. In the office of the Weather Bureau in San Francisco are to be found similar profiles for many years past. The interesting thing about these profiles is that, no matter how jagged and irregular the falling of the snow may have been, like the change of the rugged western slope of the Sierras to the sudden and precipitous eastern drop-off familiar to all Sierra-loving mountaineers, the final period of melting seems to follow an almost even law of decrease. So marked has this been found, Professor Jos. Le Conte of the University of California, in our issue of March 25, 1911, deduced a law by which the depths of snow can be foretold weeks ahead with almost positive certainty, thus affording valuable information for those preparing an outing in the Sierras and also furnishing the hydroelectric fraternity with data as to shortcomings in water storage to be expected during the season ahead.

By comparing the present seasonal chart with the two previous years mentioned, it is seen that this season with its packed snow supply now being held back in the high Sierras offers no hazardous nor alarming conditions in the way of extreme scarcity in snow storage. Hence with this assurance from the experiences of well authenticated previous years, if there is any hydroelectric brother who has imagined severe off-year conditions, he may now say to himself, like the fluttering school-girl making her first little speech: "Sit still my heart—sit still."

The Wooden Tower Line

Much is written nowadays relative to the construction of steel tower lines. Little is said regarding the wooden tower. The fact still remains, nevertheless, that in the early days of a new enterprise the eternal question of keeping down first costs until money begins to come in from consumers is a vital issue and often is the determining factor as to whether a new enterprise shall be brought to life or not.

On another page of this Journal will be found the interesting account of a novel wooden tower line construction in northern California.

The rigidity of construction attainable in the wooden tower line as opposed to the wooden pole design usually employed when 60,000 volt transmission is undertaken is shown by the fact that the spans in this installation average over 500 ft. in length and in one case a gap of 1400 ft. has been successfully crossed. The pliability of wooden towers as installed in the Northern California project reaches its fullest exemplification in rough unaccessible country such as is encountered in that portion of California.

The greatest defects met with under the wooden pole construction in former installations, like the Bay Counties line in Central California, has been the premature rotting of the pole bases or lack of rigidity at cross-arm supports. The cast iron anchor plates embedded in concrete, together with the channel iron construction used in the cross-arms, adds strength in places where weakness is as a rule felt in tower construction of this type.

The guy wires used for each tower unquestionably lessens vibration and aids materially in the taking care of unbalanced strains. The extra precautions observed every fifth pole in securing additional stability by heavier construction still further accounts for the success achieved.

The tabulated cost of line per mile shows that in a rough country the cost of material used is almost exactly equal to the additional outlay necessary for the complete installation, after all labor items and miscellaneous accounts are taken into consideration. This table of costs, indicating a total expenditure under $1800 per mile for a high tension transmission line of the proportions described and over the mountainous country encountered, gives a clear idea of the economy of reinforced wooden construction as compared with solid steel towers in the early days of a new hydro-electric enterprise.

For a Greater West

The conditions today looking toward substantial and rapid development in the great western slope of America are without a parallel in the history of nations. It is indeed true that the discovery of the Western Hemisphere by Christopher Columbus in 1492 was an event which still makes the entire world pulsate through and through in contemplation of the endless possibilities opened to civilized man in expanse of territory and acquirement of untold worldly riches. Centuries, however, have been required to make the dreams of early explorers, a concrete reality. Lack of rapid and effective means of travel coupled with the absence of all the advance in invention accomplished in the last few years, have saved for the present generation the witnessing of the crowning of commercial supremacy in a section of America where fifty years ago only a few would have dreamed of such a world-beating triumph.

The casual reader of the present day periodicals is overcome with the immense preponderance of subject matter given to topics concerning Alaska, the Pacific Coast, Western Canada, the islands of the Pacific or the Orient.

History making incidents daily accelerate this discussion. The countless human souls in China are just awakening to their latent possibilities. The cities of the Pacific Coast—Los Angeles, San Francisco, Portland, Seattle, Vancouver and Victoria—occupy a position almost on a perfect meridianal line of commercial balance or center of gravity between the Orient and the present financial centers of the world. It requires little stretch of imagination to picture in the fierce commercial struggle ahead, the transferring or readjusting of old centers to meet new conditions in world progress.

The cities of the West have built rapidly and built well. Yet it behooves all sections of the West to still further awaken to the gigantic responsibilities immediately before them. Centralization of common interests is needed, while on the other hand decentralization of interests which are purely local should be encouraged in every section. The splendid work now being done in every district of the West to prepare good roads for 1915 is undoubtedly doing more toward centralizing boosting effort than any other one thing.

The petty squabbles or jealousies, which occasionally crop out in various quarters may for the common good be done away with. How foolish does the continual and everlasting "pitty-patter" in the contention of the name for Mt. Rainier or Mt. Tacoma by citizens of Seattle and Tacoma appear to residents of California. Likewise the continual "dribble" of weather sharks and local enthusiasts as to whether Los Angeles has a better climate and more wholesome business prospects than San Francisco, must give many occasions for inward chuckling to the cities of the Northwest. As to whether Portland has the vessel of biggest tonnage putting out of any western port may temporarily bring chagrin to Seattle but it makes little for the upbuilding of a Western Empire. The West is big enough and resourceful enough for all. It behooves all to put away swaddling clothes and present a united front to the world, for the world is big enough and varied enough to want every nich and corner with all the diversifications represented in our Western Empire.

Not the least among the things to be brought about by 1915 is the still further getting together of the great commercial and populous centers now already existing on the Coast. The cities around San Francisco Bay may well consider the world power they would present by uniting into a greater San Francisco. A city of a million people, centralized in interests for all those things which result in good from centralization such as financial and engineering undertakings, decentralized into burroughs for interests of purely a neighborhood nature such as educational work, would present to the world a western power and glory never dreamed of by the visiting "wise men from the East" in 1915.

PERSONALS.

E. L. Baker, who has light and power interests at Red Bluff, is a recent San Francisco visitor.

Bertram Smith, representing the U. S. Light & Heating Company of Buffalo, N. Y., is at San Francisco.

S. G. McMeen has accepted the management of the Columbus Railway & Light Company at Columbus, Ohio.

A. E. Chandler, secretary of the American Engineering Corporation of San Francisco, is in Phoenix, Arizona.

F. G. Baum, of F. G. Baum & Co., has returned to San Francisco after an interior trip on electrical engineering business.

F. M. Ray has been chosen by the city council of Oakland, Cal., as expert adviser in fixing gas and electric light rates.

Rudolph W. Van Norden, consulting engineer, has returned to San Francisco from an extensive trip through the Northwest.

S. G. Russell of the Northern Electric Railway Company, with headquarters at Sacramento, was at San Francisco during the past week.

H. H. Noble, president of the Northern California Power Company, made an inspection trip covering a part of the system during the past week.

F. D. Fagan, sales engineer with the General Electric Company, recently gave an illustrated address on methods of illumination at Nevada City, Cal.

F. O. Sievers of the Pacific Coast sales department of the Fort Wayne Electric Works, has returned to San Francisco from a Southern California trip.

H. G. McMillan has joined the sales corps of the Fort Wayne Electric Works, being attached to the mining department, with headquarters at the San Francisco office.

P. M. Downing, engineer of operation and maintenance of the hydraulic section of the Pacific Gas and Electric Company, visited the De Sabla power station during the past week on an inspection tour.

H. R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco from Los Angeles in his automobile after spending several days in the south in connection with some large deals for his companies.

R. B. Elder, district agent for the Ideal Electric Manufacturing Company and Pacific Coast representative of the Moloney Electric Company of St. Louis, has returned to the Coast after an extensive tour of the factories and is now at Los Angeles.

R. M. Searles, vice-president of the Rochester Light and Power Company, is making an automobile tour from San Francisco to San Diego, visiting a number of electric power stations en route. He will return to San Francisco within the next week or two.

H. T. Edgar, manager of the Seattle division of the Puget Sound Traction, Light & Power Company, has announced the following appointments: **G. B. Harrington**, assistant to the manager; **Morton Ramsdell**, sales manager; **W. J. Grambs**, superintendent of light and power; **A. L. Kempster**, superintendent of railway; **G. P. James**, chief engineer; **E. C. Gaumnitz**, purchasing agent; **George Carson**, claim agent.

Cecil P. Poole, who has been the junior editor-in-chief of Power for the past seven years, has severed his connection with that paper and will on May 1 engage in consulting engineering in Atlanta, Ga., in partnership with Lamar Lyndon, of 60 Broadway, New York. The firm will operate as the southern branch of Mr. Lyndon's New York office, which will continue as heretofore. The Atlanta office will be conducted by Mr. Poole.

TRADE NOTES.

The General Electric Company has secured two orders for transformers for the Great Western Power Company for use on the Valley lines. Each contract calls for three W. C. 60, 750 k.v.a., 22,000 v. primary, 2400 v. secondary, transformers.

The California Electric Supply Company, 643 Mission street, has added to its stock a complete line of insulating materials and specialties. Everything needed in electric railway repair work is included. Joseph G. Lazarus, the sales manager, is calling on the city trade with the new line.

The General Electric Company has secured a contract for the construction of two 10,000-kw., water-wheel type, three-phase generators for the California-Oregon Light & Power Company. These will be direct connected to two 18,000-h.p. turbine water wheels which are to be constructed in the San Francisco works of the Pelton Water Wheel Company.

David Dow & Son, of Seattle, Wash., have purchased the motors the Seattle Electric Company kept on hand for rental purposes. The taking over by the Puget Sound Traction Company of the Seattle Electric Company has caused the latter concern to dispose of all their rental stock and Dow & Son willu pursue the same plan of renting motors that the Seattle Electric Company has followed.

C. F. Braun & Co., mechanical engineers and contractors, San Francisco, announce the addition to their business of a complete department for the treatment of water, including softening, filtering, sterilizing, and distilling, for domestic, municipal, manufacturing, railroad, hospital, boiler feed, and other services, including equipment from the American Water Softener Company, Forbes Company, and James Beggs Company.

The Allis-Chalmers Company has secured a contract for the complete power equipment for the Hammond Lumber Company's new sash and door plant at Los Angeles, which is to be erected at a cost of about $250,000. A new style Allis-Chalmers Corliss engine, 24x42, will be direct connected to a 575-kw., 480-volt a.c. generator, which will furnish current for a number of electric motors to be installed throughout the factory buildings.

ELECTRICAL CONTRACTORS' NOTES.

Paul Butte of the Butte Electric & Engineering Company is in Portland on business.

Harry Tittle, manager for the John G. Sutton Company's electrical department, has been laid up with tonsilitis.

The Sierra Investment Company is taking figures on a fifteen-story building on Stockton street between Sutter and Bush.

District Local No. 1, California State Association of Electrical Contractors, started a general advertising campaign at its meeting, Friday, April 26th.

H. Reid, manager of the electrical department of the Pacific Fire Distinguisher Company, is making a trip to Portland and Seattle in the interests of his firm.

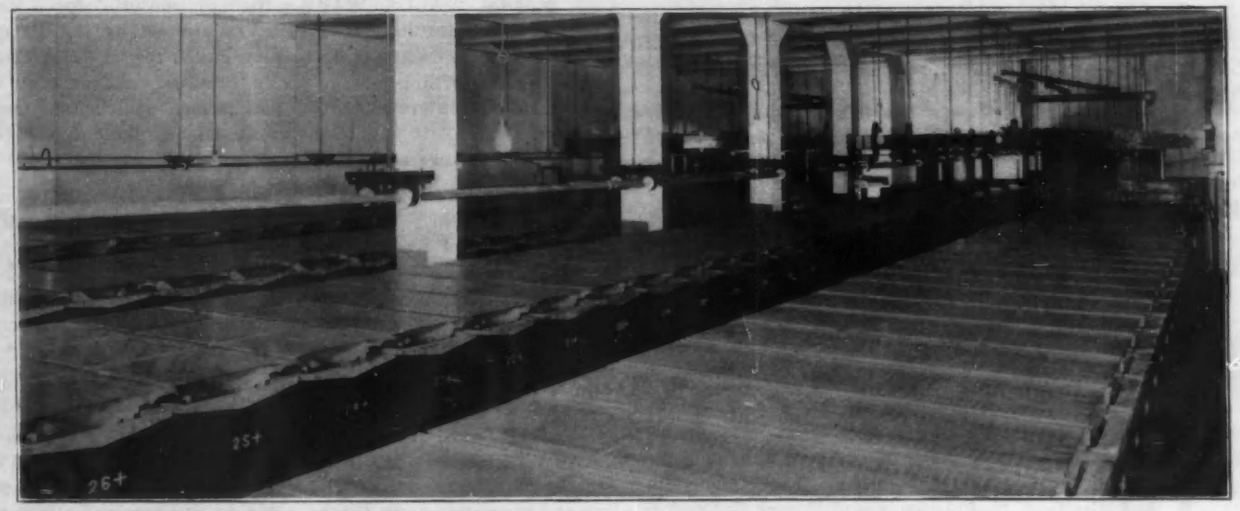
The secretary of the Electrical Contractors' Association will pay ten dollars to the party sending him by June 1, 1912, the best "schedule of a course of education" from which a series of papers can be selected that will benefit the electrical contracting, jobbing and retail supply business.

The contractors and dealers' convention was started at the Builders' Exchange Monday, April 29th. The following officers were elected: Jesse Steer, president; W. S. Hanbridge, vice-president; W. S. Scott, secretary; W. E. Burnham, treasurer. By-laws committee was appointed and everybody satisfied that at last the specialty contractors were under way for proper organization.

INDUSTRIAL

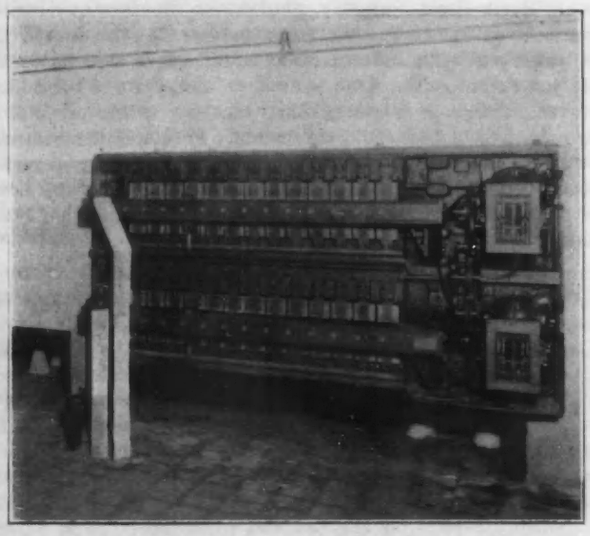
THE LARGEST STORAGE BATTERY INSTALLATION.

Electric light and power companies fully appreciate the value of having a reserve supply of electricity so that their customers can always be assured of uninterrupted service. They realize that to operate their plants without a reserve is to incur the risk of interruptions with constant trouble to their customers; while on the other hand, a proper reserve of current forms a highly valuable insurance which is a guarantee to customers of continuous service.



View of Battery Room Showing End Cell Copper.

For this reason many of the large electric lighting and power companies are installing enormous storage batteries capable of furnishing a large portion, if not, the entire amount of current necessary, for short periods of time.



High Speed Motor Driven End Cell Switch.

Unusual demands for current are caused sometimes by temporary accident to electric generating machinery, or by the sudden darkness preceding a heavy thunder storm, or, as happened last winter in New York City, by a heavy snow fall, which within ten minutes increased the demand for current on the New York Edison Company's systems from 100,000 h.p. to 166,000 h.p. In this case the rate of increase of current was so rapid that it was impossible to connect additional engines with sufficient rapidity to take care of the load and the storage batteries were called upon to meet the emergency, and thus save New York City from darkness.

The largest single storage battery ever installed has been placed in service in Baltimore by the Consolidated Gas, Electric Light & Power Company. This battery is to supply current in the possible event of failure of supply from the Westport power station and the McFall's Ferry hydroelectric plant. The cost of the building, grounds and storage battery amounts to about $400,000.

This battery was manufactured by The Electric Storage Battery Company of Philadelphia and consists of 152 cells of type H "Exide," each cell containing 133 plates, making a total of 20,216 plates. Each of the 152 lead lined wood tanks measures 4 ft. 2 in. in height, 21¾ in. in width and 6 ft. 6⅞ in. long. The total weight of the entire battery equipped with plates and electrolyte is approximately 1,079,200 lb. Fifty-two cars were required in transporting the battery and its constituent parts from Philadelphia to Baltimore. The top of the cells are fitted with heavy glass plates to prevent the electrolyte from splashing over while the battery is being charged and to reduce the evaporation of the electrolyte. The cells are arranged in four rows of 38 each and are connected with copper busbars. The floor space covered by this battery is 45 ft. by 116 ft.

This "Exide" battery will deliver 44,000 amperes at 250 volts for six minutes or 11,000 amperes for one hour. The capacity at the six-minute rate is approximately 9000 kw. The battery will be able to carry the entire direct current load to supply the power and lights supplied by the present power plant for a period of one-half hour for ordinary demands. During the day time when few lights are in use or in the early morning hours when both power and light demands are reduced, it will carry the load for several hours, of course depending upon the magnitude of the load at the time of the discharge. It is kept constantly connected to the busbars supplying the direct current service, and in the event of any interruption to the power supply, the battery will automatically assume the load without any interruption.

NEWS NOTES

INCORPORATIONS.

TACOMA, WASH.—Rainy Valley Electric Company, $25,000, by M. T. Slade, T. F. Palms, et al.

SYNAREP, WASH.—The Synarep Telephone Company, which is to build a telephone line connecting this place with Riverside, has been organized.

STOCKTON, CAL.—The Electrical Engineering and Supply Company, $25,000, subscribed $7500, by A. F. Flanagan, B. F. Wellington and Henry Adams.

SAN FRANCISCO, CAL.—The California Gas Securities Company, $100,000, shares $100 each, subscribed $500, by W. G. Loomis, W. H. Cunningham, W. R. Bacon, N. F. Wilson, O. Petroff.

LOS ANGELES, CAL.—American Power Company of California, $2,000,000, subscribed $7, by N. O. Harmon, C. M. Ferre, R. M. Blodget, H. Waterman, S. J. Powell, G. E. Harpham and W. A. Harmon.

PASADENA, CAL.—Articles of incorporation have been filed for the Jepson-Salisbury Company. The directors are Faye L. Hepson and Lewis Salisbury. They have taken over the electrical contract business formerly managed by Frank C. Sweetzer at 43 E. Union street.

SALEM, ORE.—To create water and electrical power and to promote irrigation projects is the purpose of the Mount Jefferson Power Company, which has filed articles of incorporation. The chief place of business and headquarters of the company are to be in Salem. The stockholders are: R. H. Rutherford, H. J. Lanway and Homer Rutherford. Capitalized at $5000.

SEATTLE, WASH.—Articles of incorporation of the Seattle, Kenwood & Lake Forest Railway Company have been filed with capital stock of $400,000. They propose to construct an interurban line, leaving Seattle at some point north of Ravenna Park, running in a northerly and northeasterly direction, passing through Kenwood, a new town located about two miles north of Seattle where the company proposes to establish its base of operations and build repair shops, car shops and barns, etc.

SACRAMENTO, CAL.—Articles of incorporation of the Sacramento Valley Electric Railroad have been filed. The line's estimated total length is given as 160 miles. The directors are Charles L. Donohoe of Willows, H. W. Manor of Willows, E. L. Sisson of Red Bluff, L. P. Klemmer of Willows and J. Keith Jr. of Willows. According to the rout of the line, as given in the incorporation articles, it will run from Red Bluff southerly through Tehama, Glenn, Colusa and Yolo counties to Woodland, and then southeasterly through Davis and Dixon to connect with the Oakland, Antioch and Eastern. The branch line of the Sacramento Valley Electric will run from the main line through Williams to Colusa, on the Sacramento River, following the precedent of the Southern Pacific, which recently began work on a branch to the same town. The capital stock of the new company is given at $5.000,000.

ILLUMINATION.

SOUTH BEND, WASH.—The City Council is considering a proposal to place cluster lights along the main business street.

DUNCAN, B. C.—The City Council has resolved that an engineer be secured for the purpose of investigating the best means of installing a city light and power plant.

ELGIN, ORE.—A franchise has been granted to the Eastern Oregon Light & Power Company of Baker City, giving it authority to install a light and power system in this city.

PORTERVILLE, CAL.—An application has been made to the Supervisors for a franchise for a period of 50 years, to construct a system of gas pipes along certain highways and roads in the county of Tulare. Sealed bids will be received by the board up to May 13, for the sale of said franchise.

WALLA WALLA, WASH.—Bids for material for a new $30,000 gas plant in this city, to be erected by the Pacific Power & Light Company, have been called for by Chief Engineer McGee, with headquarters in Portland, and as soon as the various bids are submitted and passed upon actual work will be started. It will be a two-story brick building located at Sixth and Rose streets.

SUISUN, CAL.—Several thousand dollars' worth of material for the entire rebuilding of the Pacific Gas & Electric light and power system in this city is here on the ground, ready for use. A considerable force of men will soon be put at work replacing old material with new, and materially increasing the efficiency of the present service. The city will be divided into districts to better facilitate service.

SUISUN, CAL.—Work on the Great Western line, which was suspended for several days, is once more in full operation. The Board of Supervisors granted a franchise last week and an additional force of men has been put at work. The franchise requires wires 30 feet above the ground and poles placed three feet from fences. The county reserves the right to remove poles when it sees fit. The line will be rushed to completion.

OLYMPIA, WASH.—With the consent of the public service commission the Puget Sound Traction, Light & Power Company has put on file new tariff schedules affecting rates for electric light and power in Seattle, Everett, Auburn, Issaquah, North Bend, Puyallup, Snoqualmie, Sumner and Ruston and power rates to Tacoma. The new tariffs take effect April 25 and abolish the old flat rates for all users as soon as the old contracts expire. This is done as the result of the adding of such things as heaters, irons, toasters, coffee percolators and the like to household equipment. Formerly the company put in a flat rate to save the cost of installing a meter, but now it is found that meters must be put in at every home to avoid virtual discrimination against the man who has a meter.

OAKLAND, CAL.—T. C. Gillespie, appraisal engineer for J. G. White & Company of New York, has filed with the City Council a report on the holdings of the Pacific Gas & Electric Company in accordance with a request made by the Council sitting as a rate-fixing committee. The figures submitted will be considered at a conference between the Council and the company officials. According to the report filed the valuation of the plant is $7,195,434. The total value of real estate is $1,133,730, of which $395,282 is charged to the electrical department and $636,480 to the gas department. The generating capital for the Oakland plant is placed at $1,029,488 and the transmission capital at $78,194, a total of $1,107,682. The total distribution capital is $2,147,109. The value of the electric substations is given as $885,600. The overhead system for electrical distribution is valued at $993,007, and the underground system at $545,706. The segregation of properties between gas and electric is based on the gross revenue for 1911 for Oakland, 55 per cent of the total

from the gas revenue and 45 per cent from the electric revenue.

TRANSMISSION.

SALEM, ORE.—D. P. Donovan, of Payette, Idaho, has filed on the Clackamas River near Oregon City, for the purpose of developing light and power.

QUINCY, CAL.—O. C. Pratt, president of the Indian Valley Light & Power Company, is arranged to extend the transmission lines from Greenville to Crescent Mills, Taylorsville and Indian Falls, early in the season.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company is applying for a county franchise over several of the roads in the county, with the intention of making extensions of its transmission lines.

REPUBLIC, WASH.—The County Commissioners have granted a franchise to the North Washington Power & Reduction Company to use the county roads for the construction and maintenance of electric light and power lines.

CENTRALIA, WASH.—The Lewis County Commissioners have granted a franchise to the Washington-Oregon corporation for a power line from Chehalis to the south limits of the county. This is the last link in the line from Tenino to Kalama.

GREAT FALLS, MONT.—It has been announced by F. M. Kerr, general superintendent at Lewistown, that work on the power line between here and Lewistown for the Lewistown Electric & Power Company will begin at once. The distance is about 120 miles and the cost will be about $2000 per mile.

RED BLUFF, CAL.—The Victor Power Company has filed notice of an increase of its capital stock from $250,000 to $500,000. The subscribed stock of the company amounts to 230,918 shares at a par value of $1 per share. The directors of the company are James H. Sharpe, P. H. Coffman, George C. Garrett, A. F. Fletcher and Alex Buick.

PORTLAND, ORE.—Plans involving the expenditure of at least $10,000,000 in the development and distribution of electrical energy have just been completed by the engineers of the Northwestern Electric Company. The plans will be carried out regardless of whether or not the Portland franchise is obtained. The Puget Sound cities offer the field for the intended operations of the company. These and all the cities of Western Washington will be invaded, according to an announcement made. The power is to be generated on Lewis, Klickitat and White Salmon rivers and all arrangements have been made for the extension of existing development plants on these streams and the construction of additional ones.

FAIRBANKS, ALASKA.—Judge Ovefield has granted the application of Receiver Charles Joynt, of the Tehama Electric Company for permission to sell the property, and August 1 was fixed as the date of the sale. The liabilities are more than $100,000. The Tanana Electric Company was established in the early days of the camp to furnish electricity for light and power in the mines on Cleary, Dome and Vault creeks. In early days the plant was situated below the mouth of Cleary and wood was used to furnish power. This was expensive, while the plant was inadequate to meet the demands. The Scandinavian American bank of Seattle and various local men financed a plan for the purchasing of larger machinery and the installation of a water power plant in 1907 on Poker creek, which enters the Chatanika River above the mouth of Cleary. This move was not successful, due to insufficient water in summer.

LOS ANGELES, CAL.—Public utility companies will be ordered to obtain franchises to place poles and wires in the streets of Los Angeles and will be subjected to many other regulations which will tend to have a deterring effect upon indiscriminate use of the streets for this purpose if the City Council adopts the report of the Board of Public Works, inclosing suggestions from the Board of Public Utilities. Following are the principal suggestions for the proposed ordinance: "That it shall be unlawful to maintain poles or wires in any public place without a franchise; before placing or removing a pole written application so to do must be filed with the Board of Public Works; deposits to be made and inspection fees charged as provided in ordinance governing excavations; poles to be placed on the inner edge of the curb, not closer than 100 feet apart, etc., as provided in ordinances Nos. 1086, L. A. G. & E. Corp., 1087 L. A. Ry., 2921 Edison Elec. Co. 4242 Pac. L. & P. Co., these ordinances also specifying the distances wires shall be placed from the ground, etc.; the Board of Public Works to have the right to designate the location of any pole or to order same removed; the poles to be thoroughly tamped in their settings in a workmanlike manner and where the surface is concreted this material shall be replaced in full squares, this to avoid patched sections; when removing poles the hole to be properly back-filled, settled with water, and where the surface has been paved, the surface is to be replaced in full squares; where guying of poles is necessary, it must be done in a manner satisfactory to the Board of Public Works; to include all poles, railway signal stands, utility companies, etc."

TRANSPORTATION.

OAKLAND, CAL.—The San Francisco-Oakland Terminal Railways Company announces an extension of the Key Route service on E 14th street to 41st avenue, beginning April 25.

SANTA BARBARA, CAL.—The local street railway system will be constructed with a loan of $5,000,000 from the Los Angeles Trust and Savings Bank. The Santa Barbara and Suburban Railroad Company, which will build the line, is now seeking a 45 year franchise, and the loan is not made unless this is granted.

PORTLAND, ORE.—Immediate construction and improvements announced by the Southern Pacific are as follows: Electrification of Jefferson street line from the city limits to Oswego, Newberg and McMinnville; electrification of West Side line to McMinnville, total distance 100 miles; building of large car shops at Oswego; building of new passenger depots at Forest Grove and McMinnville; construction of cut-off from main line at Salem to Fir on Woodburn-Springfield line; building of electrical transmission stations at Hillsboro, McMinnville and Newberg; building of $100,000 freight house on the East Side.

TULARE, CAL.—At a meeting of the Board of Trade the Four Electric Railway project was endorsed and the support of many of the members of the Board of Trade individually was pledged to the project. It was announced by David Oliver, one of the promoters of the road, that approximately $20,000 had been pledged in subscriptions in this immediate vicinity already. The engineers and surveyors expect to complete the survey to Visalia today. Sixty pound rails are to be used on the roadbed. The entire cost of the road to take in the four cities will be about $800,000. A small bond issue is contemplated and about half a million is to be raised in subscriptions.

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